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Volume No. 2

EXPLANATORY NOTES
for
DEPARTMENT OF AGRICULTURE
BUDGET ESTIMATES

Fiscal Year

1945

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(Volume 2)

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THE HISTORY OF THE
CITY OF BOSTON

From the first settlement of the
city in 1630 to the present time.
By SAMUEL JOHNSON, Esq.
of the Middle Temple, London.
In two volumes.
The first volume contains the history
from 1630 to 1700. The second
volume contains the history from 1700
to the present time.
The first volume is divided into
three parts. The first part contains
the history of the city from 1630
to 1700. The second part contains
the history of the city from 1700
to the present time. The third part
contains the history of the city from
the present time to the future.
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the present time to the future. The
third part contains the history of the
city from the future to the present
time.

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AGRICULTURAL RESEARCH ADMINISTRATION

Office of Administrator

(a) Salaries and Expenses

Appropriation Act, 1944	\$60,965
Proposed transfers in 1945 estimates, with corresponding reductions, in lieu of allotments heretofore made:	
From "Special Research Fund, Department of Agriculture" (for planning, programming, and coordination of special research projects and special research regional laboratory projects)	+21,012
From "Salaries and expenses, Bureau of Agricultural and Industrial Chemistry, regional research laboratories" (for planning and coordination of the programs of the laboratories)	+24,895
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+11,899
Total anticipated available, 1944	118,771
Budget estimate, 1945	136,656
Increase	+17,885

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase
Administration and direction of the Agricultural Research Administration	\$101,710:	\$118,771:	\$136,656:	+\$17,885 (1)
Covered into Treasury in accordance with Public Law 674	35:	--:	--:	--
Unobligated balance	1,720:	--:	--:	--
Total available	103,465:	118,771:	136,656:	+17,885
Transfer in estimates from:				
"Special Research Fund, Department of Agriculture":	-15,870:	-21,012:	--:	
"Salaries and expenses, Bureau of Agricultural and Industrial Chemistry, regional research laboratories"	-24,895:	-24,895:	--:	
Transfers from other appropriations (as shown in Budget schedules)	-62,000:	--:	--:	
Anticipated deficiency for overtime pay	--:	-11,899:	--:	
Total estimate or appropriation	* 700:	60,965:	136,656:	

* For overtime

As indicated above, the Budget Estimate provides for including in this appropriation funds previously allotted to the Office of the Administrator

from the Special Research Fund (\$21,012), and Bureau of Agricultural and Industrial Chemistry, regional research laboratories (\$24,895). A corresponding reduction is provided in the estimates for these two appropriations. Allotments were made to the Office of the Administrator from these appropriations in 1944 in the same amounts, for planning, programming and coordination of Special Research Fund projects and laboratories and for planning and coordinating the programs of the four regional research laboratories.

INCREASE

(1) An increase of \$17,885 (including \$2,885 for overtime costs) is recommended for 1945 to provide additional clerical personnel and operating expenses needed to properly discharge the responsibilities placed upon the Office of Administrator.

Objective: To assure consistency of policy and efficiency of operation throughout the Agricultural Research Administration by providing for adequate review of personnel, procurement, and financial as well as program matters in the Office of Administrator.

The Problem and its Significance: The Agricultural Research Administration comprises the Bureau of Animal Industry; Bureau of Dairy Industry; Bureau of Plant Industry, Soils, and Agricultural Engineering; Bureau of Entomology and Plant Quarantine; Bureau of Agricultural and Industrial Chemistry; Bureau of Human Nutrition and Home Economics; Office of Experiment Stations; and Beltsville Research Center. The Administration was established to provide for a closely integrated program and the effective utilization of personnel and facilities of its constituent agencies. Carrying out the purpose of the Agricultural Research Administration involves the maintenance of a technical staff to keep in constant touch with the work in the various fields of research in which the Administration is conducting investigations, critically reviewing each new individual study proposed, and assisting in every way practicable in providing for a well integrated research program to best meet the country's needs for food, feed, and fiber. Since the establishment of the Administration it has developed that in order to provide for consistency of policy throughout the organization, numerous matters and actions affecting personnel, procurement, and financial activities, as well as program matters, must be reviewed and acted upon by the Office of Administrator.

At the time of the organization of the Office of Administrator it was impossible, because of no previous experience, to estimate with complete accuracy the amount of clerical assistance needed to handle the numerous actions which must be cleared through the Administrator's office in order to provide proper integration and correlation of the activities of the Administration. Now experience has made apparent the need for additional clerical assistance. Insufficiency of help is seriously handicapping the Office of Administrator in carrying out its responsibilities and functions in an efficient manner. Staff members, because of having to attend to routine details, are not able to devote full attention to the broader problems involved in their responsibil-

ities. This undesirable situation would be corrected by making available the clerical assistance requested.

Operating expenses, particularly those for travel, are insufficient to permit staff members to maintain adequately essential contact with field research activities to the extent necessary to provide the over-all direction and coordination of functions assigned to the Office of Administrator.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	: *3,686:	\$25:	\$25
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	: 700:	11,899:	14,784
Total cost of overtime (7 months in 1943) ...	: 4,386:	11,924:	14,809

*Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

The Office of Administrator, Agricultural Research Administration, provides for direction and supervision of the Administration which comprises the Bureau of Animal Industry; Bureau of Dairy Industry; Bureau of Plant Industry, Soils, and Agricultural Engineering; Bureau of Entomology and Plant Quarantine; Bureau of Agricultural and Industrial Chemistry; Bureau of Human Nutrition and Home Economics; Office of Experiment Stations; and the Beltsville Research Center. The Administrator is also responsible for general administration of the Special Research Fund.

Functions: The Office of Administrator plans, develops, coordinates, and directs the scientific research program of the Agricultural Research Administration to assure the most effective utilization of personnel and facilities; relates the Department's research program with those going forward in private industry and in other Governmental establishments; and determines research objectives in the light of the changing needs of agriculture and of the Nation for foods and fiber.

Report of Progress: The Office of Administrator has placed special emphasis upon redirection and coordination of research in support of the war effort. Each proposed individual research project in the Administration is carefully considered by the Office of Administrator before the work is undertaken to assure coordination with other work. All estimates for funds of the constituent agencies are critically reviewed to effect all possible economies and, as far as practicable, to focus research objectives to meet emergency problems. Procedures for reports on research projects have been under study and initial steps have been taken to clarify and simplify them.

Because of their importance, particular attention has been given such activities as those relating to rubber; compression and dehydration of fruits, vegetables and meat; crop studies in support of production goals; control of diseases and insects affecting plants needed in the war effort; and other problems involved in meeting certain needs of the War and Navy Departments, the War Production Board, War Food Administration, Office of

Economic Warfare, and other agencies. The Office of Administrator maintains cooperative relationships with these various agencies and, to the problems they raise, is able to provide effectively for bringing to bear the numerous facilities and skills of the different bureaus of the Administration.

The project on meat dehydration is an example of a study in which the subject-matter fields of several of our research agencies were integrated, under the direction of the Research Administrator, to provide for a closely coordinated attack on a problem. Consultations were held and cooperation was arranged with the meat packing industry and the Food Distribution Administration. Work was started the latter part of the fiscal year 1942 and continued to June 30, 1943. The objectives of this research project have been met. Satisfactory methods of dehydrating meat and reconstituting it have been developed, as well as specifications under which dehydrated meat may be purchased for Lend-Lease purposes. Bacteriological and chemical investigations proved that the meat could be held satisfactorily for long periods of time and could be used for human consumption without danger. Digestibility and vitamin studies showed that with proper handling dehydrated meat was digestible and nutritious. Many thousands of pounds of dehydrated meat have been purchased and shipped under Lend-Lease. It was possible to complete these studies for approximately \$58,000 less than the amount allotted for the work, and the unobligated balance has been returned. A report on the results of the research is being edited for publication.

(b) Special Research Fund, Department of Agriculture
(Allotment to Office of Administrator)

This budget schedule covers obligations under an allotment for the Special Research Fund regional laboratory to conduct research into the relation of soils to plant, animal, and human nutrition, a project which is placed under the direct supervision of the Agricultural Research Administrator, since the subject matter is not exclusively within the functions of any one Bureau.

(c) Emergency Fund for the President, National Defense
(Transfers to Office of Administrator)

This budget schedule covers obligations under transfers made for emergency meat dehydration investigations; for dismantling, moving, and reestablishing laboratory equipment incident to the transfer of certain activities from Washington to the Beltsville Research Center; and for general administrative expenses in connection with emergency plant disease and insect pest prevention.

(d) Working Fund (Office of Administrator)

This budget schedule covers obligations under an advance from the War Production Board pursuant to Section 601 of the Economy Act of June 30, 1932, for directing and coordinating research investigations in food compression, packaging of dehydrated food products, and related studies.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS

Item	Obligations, 1943	Estimated obligations, 1944	Estimated obligations, 1945
Special Research Fund, Department of			
Agriculture (For laboratory for research into relation of soils to plant, animal and human nutrition)	\$105,759:	\$108,390:	\$108,390
Emergency fund for the President, National Defense:			
For emergency meat dehydrations inves- tigations	123,492:	- -:	- -
For dismantling, moving, and reestab- lishing laboratory equipment incident to transfer of certain activities to Beltsville Research Center	70,000:	- -:	- -
For general administrative expenses connected with emergency plant disease and insect pest prevention	- -:	5,000:	- -
Total, Emergency fund for the President	193,492:	5,000:	- -
Working Fund, Office of Administrator			
(For directing and coordinating investi- gations in food compression, packaging dehydrated foods, and related studies for War Production Board)	- -:	14,000:	- -
Total, Obligations under Supplemental Funds	299,251:	127,390:	108,390

1. The first part of the report
2. The second part of the report
3. The third part of the report
4. The fourth part of the report
5. The fifth part of the report
6. The sixth part of the report
7. The seventh part of the report
8. The eighth part of the report
9. The ninth part of the report
10. The tenth part of the report
11. The eleventh part of the report
12. The twelfth part of the report
13. The thirteenth part of the report
14. The fourteenth part of the report
15. The fifteenth part of the report
16. The sixteenth part of the report
17. The seventeenth part of the report
18. The eighteenth part of the report
19. The nineteenth part of the report
20. The twentieth part of the report
21. The twenty-first part of the report
22. The twenty-second part of the report
23. The twenty-third part of the report
24. The twenty-fourth part of the report
25. The twenty-fifth part of the report
26. The twenty-sixth part of the report
27. The twenty-seventh part of the report
28. The twenty-eighth part of the report
29. The twenty-ninth part of the report
30. The thirtieth part of the report
31. The thirty-first part of the report
32. The thirty-second part of the report
33. The thirty-third part of the report
34. The thirty-fourth part of the report
35. The thirty-fifth part of the report
36. The thirty-sixth part of the report
37. The thirty-seventh part of the report
38. The thirty-eighth part of the report
39. The thirty-ninth part of the report
40. The fortieth part of the report
41. The forty-first part of the report
42. The forty-second part of the report
43. The forty-third part of the report
44. The forty-fourth part of the report
45. The forty-fifth part of the report
46. The forty-sixth part of the report
47. The forty-seventh part of the report
48. The forty-eighth part of the report
49. The forty-ninth part of the report
50. The fiftieth part of the report

AGRICULTURAL RESEARCH ADMINISTRATION

Special Research Fund, Department of Agriculture

Appropriation Act, 1944	\$1,147,086
Proposed transfer in 1945 estimates to "Salaries and expenses, Office of Administrator, Agricultural Research Administration" (for planning, programming, and coordination of special research projects and special research regional laboratory projects)	-21,012
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+99,472
Total anticipated available, 1944	1,225,546
Budget estimate, 1945	1,226,364
Increase	+818

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. Special research labora- tories in major agricul- tural regions	\$661,211:	\$742,315:	\$742,315:	- -
2. Special research projects:	399,729:	458,370:	461,108:	+\$2,738 (1)
3. Administration of pay- ments to States under Title I, Bankhead-Jones Act	22,978:	22,941:	22,941:	- -
Transfer to "Salaries and expenses, Office of Secretary of Agriculture"	1,920:	1,920:	- -:	-1,920 (2)
Covered into Treasury in accordance with Public Law 674	2,914:	- -:	- -:	- -
Unobligated balance	45,378:	- -:	- -:	- -
Total available	1,134,130:	1,225,546:	1,226,364:	+818
Transfer in 1945 estimates to "Salaries and expenses, Office of Administrator, Agricultural Research Administration"	+15,870:	+21,012:	- -:	
Anticipated deficiency for overtime pay	- -:	-99,472:	- -:	
Total estimate or appropriation	1,150,000:	1,147,086:	1,226,364:	

INCREASES OR DECREASES

- (1) An increase of \$2,738 for special research projects composed of:
 - (a) An increase of \$818 for overtime pay required under the War Over-time Pay Act of 1943.
 - (b) An increase of \$1,920 for special research work made available as a result of the decrease next described.
- (2) A decrease of \$1,920 due to the proposed elimination of the transfer heretofore made to the Office of the Secretary (Office of Budget and Finance) for maintaining central accounting records.

CHANGE IN LANGUAGE

The estimates include the following proposed change in the language of this item (deleted matter enclosed with brackets):

For enabling the Secretary to carry into effect the provisions of an Act entitled "An Act to provide for research into basic laws and principles relating to agriculture and to provide for the further development of cooperative agricultural extension work and the more complete endowment and support of land-grant colleges", approved June 29, 1935 (7 U.S.C. 427, 427b, 427c, 427f); for administration of the provisions of section 5 of the said Act, and for special research work, including the planning, programming, coordination, and printing the results of such research, to be conducted by such agencies of the Department as the Secretary may designate or establish, and to which he may make allotments from this fund, including the employment of persons and means in the District of Columbia and elsewhere, [and the purchase, maintenance, repair, and operation of motor-propelled and horse-drawn passenger-carrying vehicles necessary in the conduct of field work outside the District of Columbia, \$1,147,086] \$1,226,364, of which amount [\$697,100] \$742,315 shall be available for the maintenance and operation of research laboratories and facilities in the major agricultural regions provided for by section 4 of said Act.

This change in language deletes authority for "the purchase, maintenance, repair, and operation of motor-propelled and horse-drawn passenger-carrying vehicles necessary in the conduct of field work outside the District of Columbia." This authorization is considered unnecessary in view of the general authority contained in Sec. 5 covering the purchase, maintenance, operation and repair of passenger-carrying vehicles.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$64,365	\$41,650	\$41,931
Additional funds for overtime (appropriated 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	- -	99,472	100,290
Total cost of overtime (7 months in 1943);	64,365	141,122	142,221

WORK UNDER THIS APPROPRIATION

General: Section 4, Title I, of the Bankhead-Jones Act (approved June 29, 1935) provides that 40 percent of the funds appropriated in any one fiscal year pursuant to that Title shall constitute the "Special research fund, Department of Agriculture," and shall be available for (a) administration of the provisions of the Act authorizing payments to States, Hawaii, Alaska, and Puerto Rico for research to be conducted by agricultural experiment stations; (b) special research projects approved by the Secretary of Agriculture and conducted by such agencies of the Department of Agriculture as the Secretary may designate or establish; and (c) the establishment and maintenance of research laboratories and facilities in major agricultural regions of the United States and the prosecution of research at such laboratories. Section 1 of the Act specifies that the work conducted under the Special Research Fund shall be "research into laws and principles underlying basic problems of agriculture in its broadest aspects; research relating to the improvement of the quality of, and the development of new and improved methods of production of, distribution of, and new and extended uses and markets for, agricultural commodities and byproducts and manufactures thereof; and research relating to the conservation, development, and use of land and water resources for agricultural purposes."

The actual and estimated appropriations and the authorized appropriations under Title I of the Bankhead-Jones Act for the Special Research Fund since its establishment are as follows:

Fiscal year	Appropriated			Total	Total authorized
	Regional laboratories	Special research projects	Administration of Bankhead-Jones payments to States		
1936	\$200,000	\$192,000	\$8,000	\$400,000	\$400,000
1937	400,000	384,000	16,000	800,000	800,000
1938	600,000	576,000	24,000	1,200,000	1,200,000
1939	700,000	672,000	28,000	1,400,000	1,600,000
1940	700,000	672,000	28,000	1,400,000	2,000,000
1941	700,000	672,000	28,000	1,400,000	2,000,000
1942	701,528	480,003	24,769	1,206,300	2,000,000
1943	700,000	427,000	23,000	1,150,000	2,000,000
1944	747,203 697,100	697,100 427,045	22,941 22,941	1,246,558	2,000,000
1945 (Est.)	742,315	461,108	22,941	1,226,364	2,000,000

a/ Includes \$99,472 anticipated supplemental for overtime.
b/ Excludes \$21,012 proposed transfer in 1945 estimates to "Salaries and expenses, Office of Administrator, Agricultural Research Administration."

The amount authorized, according to the terms of the Act, is distributed on the basis of 2 percent for the administration of Bankhead-Jones payments to States, 48 percent for special research projects, and 50 percent for regional laboratories. This percentage distribution was followed in the appropriations until the fiscal year 1942 when the appropriation for the Special Research Fund was reduced. Since that time, in accordance with a proviso in the appropriation act, the amount for regional laboratories has been maintained at approximately the same amount provided since the fiscal year 1939.

Special Research Laboratories in Major Agricultural Regions:

Nine regional laboratories have been established under the provisions of Sections 1 and 4 of the Bankhead-Jones Act of June 29, 1935, to provide a joint Department and State experiment station attack on problems of regional or national scope. These regional laboratories, which were established and are conducted in each case with the cooperation and participation of the State agricultural experiment stations in the respective regions, serve as focal centers for regional coordination and cooperation of research in the subjects under study by the laboratories. The work of the laboratories is centered especially upon phases of the problem under study which would be difficult or impossible for an individual State or a group of States to undertake.

The allotments made to Special Research Fund Regional Laboratories for the fiscal year 1943 and the estimated allotments for the fiscal years 1944 and 1945 are as follows:

Laboratory	Location	Allotment, 1943	Estimated allotment, 1944	Estimated allotment, 1945
1. Regional Vegetable:				
Breeding Laboratory:	Charleston, S.C.	\$69,900:	\$76,614:	\$76,614
2. Regional Pasture				
Research Laboratory:	State College, Pa.	62,260:	64,552:	64,552
3. Regional Soybean				
Laboratory	Urbana, Ill.	82,881:	92,515:	92,515
4. Regional Swine				
Breeding Laboratory:	Ames, Iowa	60,200:	64,700:	64,700
5. Regional Sheep				
Breeding Laboratory:	Dubois, Idaho	55,300:	60,239:	60,239
6. Regional Animal				
Disease Laboratory	Auburn, Ala.	61,714:	67,695:	67,695
7. Regional Labora-				
tory for Improve-				
ment of Viability				
in Poultry	East Lansing, Mich.:	102,100:	111,200:	111,200
8. Regional Salinity				
Laboratory	Riverside, Calif.	89,800:	96,410:	96,410

Laboratory	Location	Allotment 1943	Estimated allotment, 1944	Estimated allotment 1945
9. Regional Labora- tory for Research into the Relation of Soils to Plant, Animal, and Human Nutrition	Ithaca, N. Y.	\$105,800:	\$108,390:	\$108,390
For allocation by the: Secretary to meet contingencies		2,275:	- -:	- -
Covered into Treasury: in accordance with Public Law 674		2,900:	- -:	- -
Total available		695,130:	742,315:	742,315
Transfer in estimates: to "Salaries and expenses, Office of: Administrator, Agricultural Research Adminis- tration"		+4,870:	+4,888:	- -
Anticipated defici- ency for overtime pay			-50,103:	- -
Total appropria- tion or esti- mate, Special Research Fund		700,000:	697,100:	742,315

Examples of Progress and Current Program: The work of the laboratories has furnished and is continuing to furnish data helpful to the war effort. The following are examples of the progress made and work conducted at each of the laboratories during the past fiscal year:

Regional Research Laboratory for Research Into the Heredity and Behavior of Vegetable Crop Plants for the Development of Improved Varieties Having Superior Adaptation to the Southeastern Region of the United States; (Approved by the Secretary, November 30, 1935; located at Charleston, South Carolina). In our present concept of nutrition wherein it is planned to have an adequate diet for the entire Nation, vegetables play an important role. The Southeastern region is a potential source of an increased supply of vegetables both for home consumption and for export to more heavily populated areas. However, climatic conditions are both favorable and unfavorable for the production of these crops. The long growing season encourages the growing of a wide variety of crops, but, on the other hand, the temperature and humidity conditions are favorable for the disease and insects which are limiting factors in the production of high-quality products at a reasonable cost. The program of the laboratory was planned to develop varieties of vegetables of higher quality and better adapted to conditions in the region than any varieties previously available. This program was designed to develop both improved commercial varieties and varieties adapted for home gardens to increase the income of producers and improve the nutritional level of the population in the region.

In general, the production of peas in this region has been unsatisfactory because of low yields. Existing early varieties were seriously injured by the hot weather in the spring and when planted to mature earlier they were usually damaged by frost. As a result of the laboratory's breeding program, a new pea variety called Wando has been released to the trade. This new variety is extremely hardy and will survive cold spells which will kill existing varieties. Even though the blossom may be injured by such cold spells the plants will survive and produce a good crop. The variety also will produce under unfavorable conditions of heat. The peas are of good quality and are of an acceptable market type. The yield of this variety is very satisfactory and, what is of even greater significance in this region, it can be depended upon to produce a crop.

The laboratory has released another snap bean variety called Logan. This dark green podded, early, bush bean is an acceptable market type and is also well adapted for home gardens. The new variety has several attributes that make it particularly adaptable to the Southeastern region. It is resistant to mosaic disease and to blight, and is also resistant to heat.

The cabbage breeding program has developed a number of hardy lines that are high in ascorbic acid (vitamin C) content. These lines are being isolated in groups for open pollination in order to produce sufficient seed to test the varieties under large-scale field conditions.

The laboratory's tomato breeding studies have resulted in collar rot resistant strains that produce fruit approaching commercial size. Collar rot has been a very serious handicap to tomato production in the South and over-coming this difficulty will go far toward improving the nutritional adequacy of the diet of the region. The laboratory has also demonstrated that the factors for wilt resistance in the tomato is localized in the roots of the plant. This finding should simplify the task of developing wilt resistant strains since investigators can confine their observations for this factor to one particular part of the plant.

The corn ear worm is a serious menace to the production of good quality sweet corn in the region. The laboratory has developed open-pollinated sweet corn hybrids which have ear worm resistance. Seeds of these strains are now available in sufficient quantities for testing by collaborating State agricultural experiment stations. If the resistance proves satisfactory under varied soil and climatic conditions, seeds of the strains will be increased for general distribution.

In the early stages of the laboratory program a portion of the efforts of the staff was devoted to the development of improved types of watermelons. Work on this crop has been suspended during the war, except to carry the breeding material so that it would not be lost. During the period when work was in progress high quality, wilt- and anthracnose-resistant melons were developed to a sufficiently advanced stage for varietal trials after the war.

The development of chemical methods to aid in the laboratory program has been outstanding. A method for ascorbic acid determination has made it possible to analyze 250 plant samples per day with a high degree of accuracy. Without the development of such methods the breeding program for higher ascorbic acid content would have been retarded if not impossible.

Regional Research Laboratory for Research into Laws and Principles Underlying Pasture Improvement in the Northeastern Part of the United States;
(Approved by the Secretary February 20, 1936; located at State College, Pennsylvania). Milk is considered a necessary part of the diet of our population in our present wartime economy. The Northeastern States produce a great share of the milk consumed in the centers of population along the Eastern sea-coast, where the demand for dairy products has increased. In order to meet the increased requirements this region must have an abundant supply of low-cost feed in order to maintain economical production. Normally low feed supplies mean that the region must depend upon hay and pasture to supply these low-cost feeds. Many factors have contributed to a low carrying capacity of existing pastures, and climate, in a large portion of the region, limits the pasture season to a few months. The pasture improvement program of the laboratory was established to increase the productiveness of pastures in the region and to find adapted plants that will produce a greater yield of hay.

In response to the emergencies of limited supplies of protein supplements and the shortage of farm labor, the research program of the laboratory has been modified by giving more emphasis to problems of immediate significance. The State agricultural experiment stations are effectively cooperating in this program.

Pasture renovation is another phase of the laboratory program that is receiving emphasis at the present time. It is the aim of this work to increase the nutritive value and carrying capacity of existing pastures without the labor and time required to completely reseed. In this connection, simple cultural treatments and the seeding of nutritious species in existing stands of grass are being studied. The program is cooperative with the State agricultural experiment stations. Due to variations in soils and climate it is probable that different practices will be found necessary for different parts of the region.

In the phase of the program devoted to improving pasture plants, particular attention has been given to developing improved varieties of orchard grass,

Kentucky bluegrass, colonial bent grass, Sudan grass, white clover, and Ladino clover. These breeding studies have been conducted in cooperation with five State agricultural experiment stations. The work has progressed to the point where promising strains are being increased for further testing and later general distribution among growers, should they continue to give satisfactory performance. The group includes five strains of orchard grass, six strains of Kentucky bluegrass, and two strains of white clover. Numerous additional strains of these species and of colonial bent grass and Ladino clover are in various stages of development and are being tested to determine their possible pasture value.

In a pasture management and varietal evaluation study involving 15 selected strains and 2 commercial seed lots of Kentucky bluegrass, 2 clipping treatments were tested: (1) until July 1, plots clipped to $\frac{1}{2}$ inch when plants averaged 3 to 4 inches in height, after July 1, plots clipped to one inch when plants averaged 4 to 5 inches, and (2) plots clipped throughout the summer to 1 inch when plants averaged 4 to 5 inches. Total yields of herbage were greater from the plots clipped to $\frac{1}{2}$ inch during the first part of the season but yields during July and August were greater from the plots clipped at a height of 1 inch throughout the season. Some of the selected strains yielded considerably more herbage than the commercial checks, particularly during mid-summer. The results of the experiment suggest a possible means of alleviating the midseason shortage of pasturage that occurs almost every summer.

Some of the larger-growing and deeper-rooted grasses and legumes such as orchard grass, timothy, brome grass, alfalfa, red clover, and Ladino clover offer an effective means of providing adequate nutritious herbage during the usual dry, hot months of July and August. The laboratory has developed a series of chambers where weather may be controlled to study the response of these plants to temperature and day length during germination and early growth. It was found that all species except Sudan grass were seriously injured or killed at temperatures of 85° to 100° F. On the other hand, at low temperatures of 40° to 55° F. Sudan grass was seriously injured, but the other species were not adversely affected except that they grew slowly. The total growth was greater under a 16-hour day than under a 9-hour day. The ratio of roots to tops in general increased with an increase in day length and with a decrease in temperature. This information is helpful in planning pasture establishment and management.

The laboratory has placed considerable emphasis on the effectiveness of fungicidal seed treatments in the control of damping-off of pasture plant seedlings. Work in chambers where light, humidity, and temperature are controlled show that temperature and soil moisture are important in determining the degree of control of damping-off by specific fungicides. The results to date have shown that New Improved Ceresan is most effective with red clover and alfalfa while Semesan and DuBay 1205 FF were most effective with Sudan grass. Preliminary tests in the field with orchard grass and Kentucky bluegrass showed little or no effect of any of the fungicides in increasing stands with these species, while some fungicides proved toxic to seed germination. Where the limitations and effectiveness of seed treatments have been fully established it will be possible to establish new pasture seedlings with less seed than now used and with greater chance for a satisfactory stand.

In view of the present shortage of protein supplements for livestock feeding, a recent development of the laboratory may have far-reaching effects. A laboratory method has been developed for producing a high protein concentrate from pasture plants. If the product is found to have a high nutritive value and if the laboratory method can be transposed into a satisfactory commercial method, this discovery should go far toward relieving a serious livestock problem brought about by wartime conditions.

Regional Laboratory for the Development and Production of Improved Strains and Varieties of Soybeans for Industrial Uses Through Agronomic Investigations Supported by Plant Chemical Analyses; (Approved by the Secretary, February 20, 1936; located at Urbana, Illinois). The high oil and protein content of the soybean, and its adaptation to food, feed, and industrial uses, led agricultural agencies to seek a goal of 11 million acres of soybeans in 1943. An even higher goal may be set for 1944. To meet the wartime needs for oil and protein, farmers were asked in 1943 to produce 6 times as many beans as were produced during the 10 years 1930-39. Because the soybean is sensitive to environmental influences, new strains or varieties must be developed as the range of growing areas is extended. Present plans indicate an expansion of soybean acreage in the Southeast, and it becomes necessary, therefore, to test and develop varieties adapted to that region that will yield a satisfactory crop of beans with a high oil content.

As a part of the laboratory program, uniform soybean nurseries have been established in cooperation with the State agricultural experiment stations in the North Central and Southeastern regions. In these nurseries strains and varieties are evaluated for yield and adaptation. On the basis of these trials, established varieties can be assigned to areas where they are best adapted, while new breeding material can be evaluated and discarded according to their responses in the various locations.

One of the more significant developments of the past year has been the seed increase of the variety Lincoln. This strain was first tested in 1938. As a result of cooperative yield tests conducted by the laboratory, its superiority was quickly recognized and seedstocks increased so that by 1943 more than 500 acres of the variety were planted for seed in the North Central States. In 4 years the cooperative program of the laboratory has achieved what formerly required 10 years for an individual station to accomplish. This new variety has yielded 24 percent more beans per acre with considerably higher oil and protein content than the average of the 2 most commonly grown varieties in the soybean belt. It is estimated that had this variety replaced other varieties in the area to which it is adapted it would have added at least 30 million bushels of high oil-content beans to the Nation's 1942 soybean crop.

The laboratory has developed and distributed breeding stocks containing the best of the germ plasm discovered in the uniform nursery tests. In order to complement the stocks of material of medium maturity made available in the past, a rather comprehensive group of crosses have been made. These embody the more important early varieties in combinations among themselves and with later strains outstanding in yield, quantity and quality of oil, resistance to lodging, and other agronomic characters. These stocks have great promise of producing superior strains adapted to the Northern States. For example, the new variety Lincoln has been crossed with an early variety from Canada -- Pagoda -- backcrossed to Lincoln to secure a strain with the desirable characters of

Lincoln and early-maturing enough to be grown in the Northern States. Similarly, the Lincoln variety has been crossed with the Richland variety in an attempt to secure a strain with the high yield and high percentage of oil of Lincoln combined with the earliness and lodging resistance of Richland. More than 500 selections of this latter cross are being tested in Illinois, Iowa, and Ohio. This cooperative testing will make possible a more rapid discovery and evaluation of the improved strain sought.

With the expansion of the soybean program to the Southern States, the laboratory has established two additional uniform nurseries in that area where the best of adapted varieties and the more promising southern selections are being tested. Chemical analyses of some 500 samples of these varieties and strains were made by the laboratory to determine the protein and oil content and the drying quality of the oil. Results of the analyses indicated a few high-oil strains of promise for use as breeding material, among them being such named varieties as Ogden, Magnolia, Herman, and some lines of Arksoy. The consistently favorable reports on Ogden merit an effort to increase seed-stocks for distribution.

In order to determine how early a true estimate of yield and composition of seed may be obtained, the laboratory harvested 4 varieties of soybeans at frequent intervals from the time the seed was half developed in the pod to the time of full maturity. For each variety the dry weight of seed was not significantly different between the rows harvested when the beans were fully grown in the pod and the rows harvested at later dates including full maturity. The percentage of protein and oil in the seed was nearly constant during this period. Iodine number of the oil showed no appreciable change during this period indicating that the unsaturated fatty acids had been laid down by the time the seed had grown to full size; and no appreciable shift in degree of unsaturation occurred during the maturing of the crop. These results show that soybeans may be harvested at any time after the seed has developed to full size and the performance of the strain as to yield, seed size, and composition of oil and protein evaluated.

Because frost damage has caused much loss to farmers in some years, the laboratory separated several samples of beans into three classes: sound seed, partly frost-damaged seed, and frost-damaged seed, and analyzed them to measure the effect of frost damage on composition. No significant difference in oil content was found between the sound and frost-damaged seed. However, the iodine number of the oil was slightly lower and the free fatty acid content higher in the damaged samples. The oil from the frost-damaged samples showed a green color due to chlorophyll. The discoloration and higher fatty acid content decrease somewhat the value of the seed for industrial use. On the basis of these results it is recommended that frosted soybeans be harvested promptly after the crop has dried to a point where the seed may be combined and will store satisfactorily. Frosted beans are more susceptible to mold growth and will deteriorate more rapidly in the field than sound beans under adverse weather conditions. Field damage is usually more harmful to the value of the crop than is frost damage, as the oil is more difficult to extract from field-damaged seed and is of an undesirable color difficult to refine.

Regional Research Laboratory for the Improvement of Swine Through the Application of Breeding Methods; (Approved by the Secretary, December 22, 1936; located at Ames, Iowa.) Swine constitute one of the self-reproducing factories on the farms of the United States. They convert products of the soil into refined products that support human life. The ability of hogs to convert 15 bushels of corn into 200 pounds of highly-prized human food, suitable for consumption as fresh meat or for cured cuts to be stored and consumed when needed, has made them an important part of the agricultural industry. Hogs have produced nearly half of the total tonnage of meat produced in the United States for many years and the 1942 hog slaughter stands as an all time high. Hogs have an added importance due to the fact that their numbers can be increased quickly in cases of emergencies and without serious dislocation of other agricultural enterprises.

Results from experiments in breeding animals conducted prior to 1935 made clear the need for more extensive experimental effort to extend and apply the science of breeding in their further improvement. The high cost per unit and the slow rate of reproduction, even in swine, have been major obstacles in experimental breeding of farm animals. Cooperative effort between State agricultural experiment stations and the U. S. Department of Agriculture seemed to offer a satisfactory approach to the problem. The different phases of the laboratory program are being pursued through cooperative projects in progress at the Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, and Oklahoma Agricultural Experiment Stations. In addition, the Ohio, South Dakota, and Wisconsin Stations have initiated projects that are closely coordinated with the basic program. As a measure of the magnitude of this cooperative undertaking, a total of 633 litters in the various inbred lines were farrowed in the spring of 1943, and it is expected that approximately 300 litters will be farrowed in the fall of 1943.

Data obtained by the laboratory during the year added support to the conclusion that skillful swine breeders can breed closed herds, herds in which no outside blood is introduced, successfully. Herds in which 3 to 5 sires per generation are used and in which selection is based on performance can be expected on the average to perform favorably in comparison with outbred herds until the inbreeding is increased to 30 percent or more. Crosses of lines within breeds which have been inbred 25 percent or more can be expected to produce pigs with increased vitality and rate of growth in comparison with the present lines.

The laboratory is using the available information to develop methods not dependent upon human judgment for use in selecting breeding animals. In this phase of the work it was found that variations in scores of live hogs weighing approximately 225 pounds seem to be about 20 percent heritable. An index based on productivity of dam, sire, growth rate of pigs, and performance of close relatives apparently is about 3 times as efficient in selecting stock as score alone. The usefulness of weights as a basis for selection increases as the age of the pig increases up to about 150 to 168 days of age. Variations in productivity of sows are approximately 16 percent heritable.

In selecting for characters such as productivity of sows and growth rate of pigs the laboratory has estimated that at least one-third of the boars available at weaning time should be retained until they are between 120 and 180 days old when final selections can be made. This means that from 5 to 10

times as many boars should be saved at weaning age as are to be used. Also from one-third to one-half of the best performing gilts should be retained for second litters.

Based on information collected at the laboratory, the functions which are of most importance to swine producers and the qualities preferred in hog carcasses appear to be associated with length of body up to an optimum of 40 to 42 inches in well-fed hogs weighing 225 pounds. This body length is measured from the tail setting diagonally along the side to a point between the ears. These hogs are also 11 to 12 inches wide and 14 to 15 inches deep back of the shoulders.

During the year 2 inbred lines have been added to the laboratory program. The lines now on hand range in inbreeding from about 10 to more than 70 percent. Thirty-nine of these lines are within 5 pure breeds and 3 are from cross-bred foundations. Individual excellence and performance of some lines apparently have improved in some respects as the inbreeding advanced. In general, however, a decrease in size of litter, vigor of pigs, and rate of growth has occurred as the inbreeding increased. The inbred lines were crossed in many combinations during the year and 139 litters were farrowed this spring from cross-line matings within the purebreds, and 33 litters were produced from lines of stock of different breeds.

Approximately 150 boars and 200 sows of the various inbred lines were placed in the hands of farmers during the year. While reports of the performance of the stock are incomplete, such reports as have been received, for the most part, are complimentary to the stock.

A total of 19 herds in Minnesota are using breeding stock obtained for the Minnesota project. Some of these animals are from the Minnesota No. 1 (Landrace-Tanworth) line, while others are inbred Poland Chinas. An inspection of these herds revealed that boars of the No. 1 line stamp their character on their offspring regardless of the breeding of the sows they are mated with. Pigs by these boars are growthy, vigorous, alert, and of high quality. In conformation the pigs are similar to the Landrace, but are slightly shorter in length of body, stronger in the back, and definitely superior in feet and legs. In rate of growth the pigs equal or exceed animals of other breeding with which they are grown. Expressions of the farmers regarding the pigs varied from that of mild satisfaction to a high degree of enthusiasm. Some farmers emphasized that they had received from 10 to 15 cents per hundred weight above the top of the market for hogs by Minnesota No. 1 boars.

The Minnesota No. 1 hogs are quite different in type from established domestic breeds. In general they are leaner, shorter-legged, longer-bodied, trimmer-jowled, and flatter-backed than present breeds. These animals approach the bacon-type hog. If in the near future the markets show preference for hogs of the so-called "meat type", the Minnesota No. 1 hogs in the hands of farmers will serve as pilot stock. These animals will serve as a focal point for accumulating evidence to determine the type of desirable hog before general emphasis is placed on changing markedly the type of existing breeds.

Regional Research Laboratory for the Improvement of Sheep for Western Ranges through the Application of Breeding Methods; (Approved by the Secretary, February 24, 1937; located at Dubois, Idaho.) Western agriculture is characterized by the production of vast tonnages of roughages, concentrates, and farm byproducts, and is dependent for its success on the consumption of these products by livestock. The range sheep industry, an essential part of the region's agricultural economy, involves approximately 33,000,000 head. These animals produce annually about 275 million pounds of wool or somewhat more than two-thirds of the nation's supply. Approximately 65 percent of the nation's lamb tonnage also originates within this area. Together with range cattle and horses, the sheep harvest the annual crop from approximately 394 million acres of public domain, State lands, National Forests, and Indian reservations as well as from millions of acres of privately-owned grazing land.

The laboratory has as its objective the improvement of range sheep that will excel present sheep in adaptability, yield, and quality of wool, and in lamb production. Inbreeding is used in the breeding program in order to concentrate in the least possible time the desirable characters such as acceptable market form of lambs, and the production of an increased quantity as well as quality in wool. The characteristics in sheep that are of greatest value in range production are given the most emphasis in the breeding program.

As reported last year, inbreeding tends to decrease the staple length of the wool, the grease fleece weight and the body type score. On further examination of the data it appears possible that, on the average, careful selection may counteract or more than counteract the decrease in these factors when inbreeding increases about 4 percent per generation. It would be expected that some inbred lines would respond more favorably to selection than other lines.

In order to determine the effect of outcrossing inbred ewes the laboratory mated some which were small in size, apparently due in part to inbreeding, to unrelated rams. These ewes were 28 percent inbred and had averaged 8 pounds lighter at weaning time than the average of their dams. The offspring of the above mating were 15 pounds heavier than their dams at the same age and were approximately the same weight as the average of the lambs from all lines. These results show that outcrossing may restore in one generation the loss in size when that deficiency arises as a part of an inbreeding program.

The laboratory has estimated from studies involving 1,622 daughter-dam comparisons that body weight has an heritability of 40 percent, neck folds 26 percent, and body type 12 percent. These figures indicate that heritability for the traits of greater economic value in range sheep are sufficiently high that considerable progress can be expected from careful selection for these traits.

Through careful selection and breeding the laboratory has made definite progress in eliminating the burdensome extraneous skin folds in the Rambouillet flock. There is a tendency for Rambouillests to have folds immediately below the eyes. These folds serve no useful purpose and are most common in wool-blind sheep. Of the 1942 weaning lambs 84 percent were scored

free or almost free of skin folds. The elimination of this undesirable trait will increase the opportunity for selection of useful characteristics.

An animal's true wool-producing ability is much more accurately determined by making clean yield determinations annually, due to the great variation that exists between years in grease fleece weights. For fine wool produced by yearling Rambouillet sheep, the average clean yield varied 15.2 percent between 1939 and 1942. Much of the difference was due to seasonal variation but during the past three years the staple length of the fleeces has increased from 2.17 inches to 2.41 inches. This one-quarter inch increase in length is quite significant for fine wool sheep. The added length had some influence on the clean fleece weight, which increased .83 pounds in 4 years, from 3.17 to 4.0 pounds. The grease fleece weights were 1 pound lighter in 1942 than for any of the other 3 years, but the clean fleece weights were greater.

The laboratory has determined that in fine wool produced under range conditions by 1,147 Rambouillet yearling ewes, each half-inch increase in staple length was responsible on the average for a 1.0 pound increase in grease wool, 0.7 pound increase in clean scoured wool, and a decrease of 3.3 percent in shrinkage. When the fleeces were grouped according to grade the average clean fleece value per fleece for the strictly fine combing staple wool was \$5, for French combing wool \$3.56 and for short wool, approaching clothing length, \$2.92. Length is, therefore, a very vital factor in determining economic returns.

Although the total number of animals remained practically the same, the number of inbred lines in the laboratory breeding program were reduced from 37 to 30 in the fall of 1942 by eliminating or combing in those which showed the least promise of developing into useful lines. The average inbreeding coefficient for all offspring in 1943 was 8.87 percent, while the comparable figure for 1942 was 8.62 percent. While significant sire or line differences are found for each of six characters considered, it seems probable that these differences are due more to differences in the original selections of animals to make up the various lines than to the effect of inbreeding in pulling the lines apart.

Regional Laboratory for Study of the Mechanism of Infection in the Contagious, Infections, and Parasitic Diseases of Domestic Animals and Poultry, and Methods of Control in the Southeastern Region; (Approved by the Secretary, February 24, 1937; located at Auburn, Alabama). Livestock and livestock products are more than ever essential in preserving the nutritional level of the diets of our military and civilian populations. In order to keep this supply of nutritionally important products at maximum economic levels it is necessary to protect the animals themselves from diseases and disorders that are responsible for either mortality or poor production. Because of favorable climatic conditions, and because of the program for diversification, there has been a marked increase in livestock populations during recent years in the Southeast. However, certain factors, notably climate, that recommend themselves to livestock production in this area, also constitute hazards to the industry. The long summer and the absence of prolonged cold periods are favorable to the persistence of diseases and parasites, conditions that are responsible not only for direct losses of animals but also for such indirect losses as decreased production of meat, milk, wool, and eggs.

The laboratory program was planned to develop methods for combating the problems of major significance in the region. The knowledge and techniques obtained in these original studies will serve as guides for determining the nature and means of control of other diseases and parasites of domestic animals.

The laboratory isolated two strains, one from cattle and one from sheep, of the common stomach worm, Haemonchus contortus, and passed each through seven generations in its original host strain. It was found that the strains developed in both host species, but the cattle strain developed better in calves than in sheep, and the sheep strain developed better in sheep than in calves. This cross-transmissibility of the parasite from sheep to cattle and vice versa may have an important bearing on livestock rotation on pastures.

In studies of experimental infections with the lesser stomach worm, Ostertagia ostertagi, it was ascertained that parasite eggs appear in the feces of infected calves 19 to 31 days after exposure. The infective larvae penetrate the mucus membrane of the wall of the stomach, and each worm produces a small nodule visible to the unaided eye. Some of these nodules are gray, while others are hemorrhagic. A single animal, given more than 1,000,000 larvae at one time, went off feed during the second week, developed intermittent diarrhea, and died on the 25th day. At autopsy the mucosa of its stomach was found thickened and severely hemorrhagic. Calves experimentally infected with O. ostertagi did not develop any significant anemia.

Natural resistance to internal parasites, such as has been reported in sheep, has not been found in any of the cattle studied at the laboratory. Treatment with phenothiazine for the removal of stomach worms, nodular worms, and other pathogenic roundworms from the alimentary canal of cattle was developed and standardized as to dosage and safety by workers in the laboratory. This treatment is being used widely by veterinarians and stockmen in the Southeast and elsewhere in the United States and is rapidly displacing less effective medication used in previous years.

The laboratory has been cooperating with the owners of three herds infected with Johne's disease. Testing all of the cattle with johnin followed by slaughter of all reactors has resulted in satisfactory progress toward eradication of the disease. In one of these herds which was herds which was having heavy annual losses with classical symptoms of Johne's disease the program has stopped such losses.

Stained smears of the intestinal mucosa of 29 cattle, which reacted to tuberculin, the diagnostic agent used in testing for tuberculosis, but which showed no visible lesions of tuberculosis at autopsy, were examined. In 10 of these, organisms indistinguishable from mycobacterium paratuberculosis were found. These findings lend further evidence to the possibility that many of the so-called no-visible-lesion reactors to tuberculosis tests are affected with Johne's disease.

Continued studies with johnins, the diagnostic material used for identifying infected animals, have shown that they retain their potencies for at least 20 months even when held under adverse temperature conditions. Comparisons of different lots of johnin indicate that some strains of M. paratuberculosis

produce more potent johnins than do others. It was possible for the first time to establish experimental infection of Johnie's disease, in a few cases, by the administration of M. paratuberculosis organisms in cream as a drench to calves.

Continuing its studies of coccidiosis of cattle, the laboratory examined approximately 2,500 fecal samples from 1,250 cattle, representing 189 dairy farms in the Southeast. These studies resulted in the following findings: (1) calves less than three weeks old very seldom voided oocysts; (2) Eimeria ellipsoidalis, the parasite commonly associated with non-bloody scours, was the dominant species in calves 3 to 12 weeks old; (3) E. bovis, which produces bloody scours, predominated in cattle from 4½ months to two years of age; (4) E. zurnii, the most pathogenic species of bovine coccidia, was found in approximately 50 percent of all cattle examined which were between the ages of 1½ and 12 months; and (5) carrier animals, harboring these three species, were found in every herd examined. The latter finding shows that there is constant danger of a severe outbreak of coccidiosis where crowded and insanitary conditions prevail.

The laboratory has determined that clinical coccidiosis can be controlled and prevented by management practices which prevent exposure of calves to excessive numbers of sporulated oocysts. This has been accomplished by keeping calves in clean individual pens, moving them to other clean pens before infection builds up, and finally placing them in pastures which are not crowded. The period of protection in the pens tides the animals over the critical stages of early life and the light infections they inevitably acquire while in these pens tend to build up an immunity to the heavier infections which may be acquired later. A number of the more progressive dairymen in the Southeast are following this method of prevention with marked success.

Regional Research Laboratory for the Improvement of Viability in Poultry; (Approved by the Secretary, December 23, 1937; located at East Lansing, Michigan.) The poultry industry of the United States is making a tremendous contribution to the present war effort in spite of the fact that it is beset by a difficult mortality problem expressed in several forms. The annual mortality of at least one adult hen in every five on the farms continues to be the greatest limiting factor to poultry and egg production. This loss is supplemented by an estimated mortality of ten percent among the young chickens. In addition, a high mortality prevails among the males, and financial returns from poultry products are reduced because of the morbid condition of the birds prior to the time death occurs. The yearly financial losses from mortality alone will exceed \$130,000,000 when figured on the basis of the number of laying hens and young chickens on farms and the prices received by farmers as reported July 1, 1943.

Approximately 40 percent of the total poultry mortality is from lymphomatosis, one form of the avian-leukosis complex manifested by paralysis, gray eyes, and enlarged livers and other visceral changes. Mortality from lymphomatosis among the mixed population of chickens hatched in 1943 at the laboratory, exclusive of those which died from cannibalism and from causes which could not be determined, amounted to 28.3 percent by the time the birds had attained an average age of 356 days. The variation in the death rate among the progeny of 19 matings ranged from a low of 7.1 percent in one mating with 28 original

progeny to a high of 53.3 percent in another mating with 45 original progeny. The difference in mortality of over 46 percent may be accounted for in the breeding of the chickens, as they were supplied with the same kind of feed and were raised under similar environmental conditions.

During the time research has been in progress at the laboratory there has been an increased proportion of cases of enlarged livers, and other visceral manifestations of this disease complex and correspondingly fewer cases with paralysis and gray eyes. A somewhat similar transition has been reported by research workers at State experiment stations, and by farmers. As a result of this condition many producers claim that their chickens are no longer affected with the avian-leukosis complex. Nevertheless, they continue to have as much mortality as formerly but since clinical manifestations of the visceral form of the disease are not evident a false sense of security is built up.

For the first time the laboratory raised 91 White Leghorn chickens to an average age of 300 days without a single case of lymphomatosis. At the close of this period 47 of these birds were subjected to a thorough and complete clinical and post mortem examination and tissues were saved for critical microscopic study. Although one lesion that was suggestive of lymphomatosis was observed in a tissue at the time frozen sections were examined, it was not possible to substantiate this observation by examination of multiple sections of nerve tissues.

In a second group of 51 chickens composed of sisters of those reported in the preceding paragraph, there was a mortality from lymphomatosis of 27.5 percent in 300 days.

The two groups of chickens were hatched in the spring of 1942 from eggs produced by a mating of 4 hens and a male from two families which had not shown any clinical manifestations of lymphomatosis up to the time the matings were made. The eggs producing the 91 chickens were incubated with eggs from other families for an 18-day period, after which the eggs from each hen were transferred and hatched in small incubators located in different pens. The chickens were brooded and maintained separately in these isolated pens throughout the entire period of 300 days under rigid quarantine and in complete confinement. The second group of chickens came from eggs that were incubated and hatched with other families. They were brooded and maintained in confinement but under less rigid quarantine than the other group, and with chickens from other families in which cases of lymphomatosis subsequently developed.

The above experiment adds to the evidence already accumulated at the laboratory that lymphomatosis is transmitted from parent to offspring through the hatching egg and that the disease is definitely transmitted through mechanical means and by contact with infected chickens. The high incidence of lymphomatosis among these brooded and maintained with the mixed population demonstrated that chickens of this breeding were susceptible to the disease.

The development of stock free of lymphomatosis is highly significant. If such stock can be further developed and maintained the results of research at the laboratory can be evaluated more accurately, further critical research on transmission will be possible and effective, and free stock will provide

the best of material for establishing the normal anatomical and the normal physiological patterns of the chicken. If subsequent research on transmission now in progress confirms these results they will have far reaching effects on the poultry industry. Every conceivable effort will be made to reduce the amount of lymphomatosis among the 1,000,000,000 chicks which are hatched annually in the United States by obtaining hatching eggs from stock free of the disease. Such a program will call for ways and means of not only identifying such stock but the adoption of quarantine measures for maintaining it.

Experience at the laboratory leads to the conclusion that when lymphomatosis is reproduced by inoculations the time between infection and the appearance of clinical manifestations is variable, extending over a period of a few weeks to many months. This extended period reduces the number of chickens which can be maintained and governs to some extent the number and the character of experiments that are initiated. To overcome to some extent the handicap of a long incubation period certain variants of the lymphomatosis agent are being studied. The variants with a much shorter incubation period should aid in bringing about a solution to the problem if it is determined that they are associated with the parent disease.

Regional Laboratory for Investigations of the Relationship of the Salinity of Irrigation Waters, and of Soil Conditions to Plant Growth and Related Factors Involved in a Permanently Successful Agriculture in the Western Region; (Approved by the Secretary December 23, 1937; located at Riverside, California). About 9 million acres of the estimated 20 million acres under irrigation west of the Mississippi River have had their productivity impaired or threatened by excessive accumulation of soluble salts. To provide the food and feed required to meet military and civilian needs of this country and of our Allies, it is essential that all land suitable for cultivation produce crops as efficiently as possible. For the prevention of salt accumulation in irrigated districts, and for the removal of salts present in harmful amounts, good drainage is necessary. In planning effective, economical drainage systems information should be available on location of water tables, conditions as to outlets, absence of upward-moving water because of pressures from below, and rates at which water will move through the soil strata. The laboratory is developing and improving methods for measuring these factors, is determining management and cultural practices that will reduce the effects of salt accumulations, and is ascertaining under what conditions plants will grow under alkaline conditions.

In irrigation agriculture the rate at which soils will "take water," or transmit water to the subsoil or root zone is important. In some soils this rate is as great as six inches per hour, while in a few other soils the rate has been found to be so low that twenty days' time would be required for a six-inch irrigation to pass downward. Tests made at the laboratory have shown that additions of gypsum and organic matter will increase the permeability of soils. On the other hand, fertilizers containing sodium may reduce permeability, especially if the fertilizer is applied in concentrated bands or in a concentrated solution. As a matter of fact, citrus growers in southern California have observed that their soils absorb irrigation water less readily after using wartime fertilizers containing sodium. This change in fertilizer practice has resulted in an increase in the time and labor required for irrigation or in a readjustment of the irrigation system. Since in truck crop agriculture the fertilizer is usually applied between the irrigation furrow and the

plant, the use of fertilizers which reduce permeability also may retard the movement of water to the root zone.

The laboratory found that it was difficult to wet the soil at depths of two to five feet in a date palm orchard. The irrigation water which had been used previously was low in total salt content but 80 percent of the bases present were sodium. It was found that drying out the soil between irrigations and making heavier applications of irrigation water at less frequent intervals resulted in water penetration to the five-foot level. With deeper penetration the salts in the surface soil were leached into the subsoil and beyond the feeding range of the greater part of the root system. Additions of organic matter and gypsum also aided penetration but were not as effective as the drying-out technique.

Continuing its efforts to develop improved instruments for measuring the amount of water in the soil that is available to plants, the laboratory developed a sorption block apparatus for the purpose. A small ceramic block about the size of a 5-cent piece in contact with the soil will absorb moisture until the moisture-holding forces in the soil and in the block are in equilibrium. This block can be weighed quickly on a spring balance and the amount of absorbed water, equal to the increased weight, is a measure of the amount of water in the soil. While the apparatus appears to be too fragile or delicate for use by farmers in its present form, it is hoped that more rugged models can be perfected later.

Greenhouse and outdoor sand culture experiments at the laboratory with over a dozen crops have shown that reductions in plant growth are roughly proportional to the increase in salt concentration. In an attempt to correlate this finding with field conditions, the concentration of the soil solution in 17 western soils was determined and correlated with plant growth in the field. Since the greatest salt concentration which plant roots encounter in any soil is found when the moisture content approaches the wilting range, the above soil solutions were obtained at moisture contents nearing the wilting range by means of the pressure membrane apparatus described in last year's reports. Salt concentrations in these soils ranged from 1.3 to 235 atmospheres (2300 to 339,000 parts per million). The soils were barren where the salt concentration exceeded 40 atmospheres. Below 10 atmospheres the degree of plant growth reduction was proportional to the concentration. These results are important in that they indicate that results obtained in the greenhouse are applicable to the field. Other studies at the laboratory with soil samples from 8 saline areas in Utah, Colorado, and California indicate that for many areas it is practicable to take several hundred pounds of soil to the laboratory and over a course of a few months determine if the soil can be reclaimed economically and the method to accomplish it. Such a method will save many mistakes in attempting to reclaim areas already abandoned because of salt concentration.

Tests on the tolerance of crops to salinity have been continued at the laboratory. Guayule was found to be only moderately tolerant to saline conditions. Wartime demands for linseed oil have resulted in a marked increase in flax acreage in the Western States. Some of the increase has been planted on lands that are moderately to highly saline. Under greenhouse conditions it

was found that regardless of the salt used in the basal nutrient solution, there was a significant reduction in the height, dry weight of tops, and total weight of seed produced by flax plants at the high salt concentrations. Except at the higher concentrations using sodium sulfate in the nutrient solution, neither the salt used nor the concentration of the salt had a significant effect upon seed size, oil content, or iodine number.

Regional Research Laboratory for Research into the Relation of Soils to Plant, Animal, and Human Nutrition; (Approved by the Secretary, January 1, 1939; located at Ithaca, New York). Physiological disorders of man and animals in certain sections of the country have been recognized for many years. The causes of most of these disorders have been identified as a deficiency of one or more essential nutrients in the food or feed eaten. In recent years nutrition and medical experts have become interested in the role of soils in supplying to man and animals, through the medium of the plants grown on them, the nutritional factors required for normal health and well-being. From a national nutrition standpoint it is essential to know what areas are producing adequate foods and feeds and what areas are supplying inadequate foods and feed to the men and animals residing there. In the latter case it is also necessary to know the extent and nature of the deficiency so that it may be corrected by direct additions to the diet or supplied to the plants in the form of fertilizers or by other agricultural practices.

The program of the laboratory is designed to analyze and evaluate the effect of the mineral elements in the soil on the nutritive value of the plants grown on them. It is known that continuous cropping will deplete soils of certain mineral elements but it is necessary to know what effect this reduction may have on the efficiency of plant production and the measures that may be taken to correct them. When facts are known on the soil-plant relations it will be possible to accurately plan our national nutritional economy.

A study was made of the effect of deficient supplies of the micronutrients (manganese, zinc, copper, molybdenum, and iron) on the tomato plant. Failure to supply these elements to the plants resulted in marked decreases in growth and fruitfulness but the vitamin content (provitamin A, ascorbic acid, and riboflavin) of the fruit was not greatly affected. Previous work at the laboratory indicated that variations in the supply of macronutrient elements (calcium, potassium, magnesium, phosphorus, nitrogen, and sulfur) produced no material effect upon the ascorbic acid and provitamin A content of tomato fruit. These results indicate that any fertilization practices employed by the farmer designed to increase crop yields will not limit the nutritive value of the tomato.

The results of several years' work with tomatoes and results obtained during the past year with pineapple fruit and turnip greens all indicate that the ascorbic acid content is materially affected by the location where the plants were grown. These variations show no correlation with soil conditions but rather seem to be correlated with climatic conditions, particularly with light intensity. With turnip greens ascorbic acid content increased more than 100 percent within a period of two or three days as a result of increasing the intensity of artificial illumination from 800 to 5,000 foot candles. Variations in temperature during the growing season appear to be of much less importance.

Tomato plants grown in soil and in sand cultures at various locations and under differing environmental conditions were analyzed for provitamin A (carotene) content. The results showed that differences in carotene content were correlated with varietal conditions, but the particular varieties studied did not differ greatly. Ripe fruit produced in the greenhouse whether in summer or winter were lower in carotene than fruit produced outdoors during the summer. Fruit picked green and ripened in storage were very much lower in carotene than vine-ripened fruit.

It has been shown that the utilization of carotene by animals may depend to a large extent on the plant species in which the carotene is found. While the carotene of green leafy plants is almost wholly utilized by the rat, only about one-third of that in the carrot is utilized.

Laboratory animals have been made anemic by feeding them a diet low in copper and in iron. An intensive study was made of the blood of these animals in order to extend the knowledge of these mineral elements in the formation of blood and to aid in determining the dietary requirements. In the rat, a deficiency of blood only produces a severe anemia, characterized by red blood cells which are low in hemoglobin and smaller than normal in size. A deficiency of copper alone produces an anemia characterized by cells low in hemoglobin but nearly normal in size. The simultaneous deficiency of copper and iron produces an anemia similar to that induced by iron deficiency alone, but not quite as severe.

During the year the laboratory analyzed for thiamine (B_1) content about 3000 samples of wheat of different varieties grown at various locations throughout the United States. The location where the plants were grown produced a marked influence upon the relative amount of thiamine present. Certain locations gave values almost twice as high as other locations. In general, a variety which tended to be rich in thiamine at one location was relatively rich at all locations, and varieties which were low at one location tended to be low at all.

Studies of native pastures and of forage crops from the coastal plains of North Carolina and Massachusetts confirm earlier conclusions that a deficiency of cobalt exists in both areas. Cattle produced in areas where cobalt is deficient in the native plants become gaunt due to loss of appetite. The animals are listless and anemic, the hair coat becomes long and rough, and the skin is scaly. Under extended exposure to the deficiency muscular atrophy develops and eventually death occurs. In North Carolina cobalt deficiency is accompanied by a low manganese content of the forages while in Massachusetts the iron is low. These multiple deficiencies have prevented a normal development of dairy and beef cattle. Troubles with sheep and hogs also occur in North Carolina. A survey was made of pastures and hay lands in the Northeast where a trouble in cattle called "grass tetany" has been reported to be associated with intensive fertilization with nitrogen, potash, and phosphate. It seems possible that this intensive fertilization may have accentuated incipient deficiencies of certain other elements in the soil.

Preliminary results with new techniques developed by the laboratory to study the effects of fertilizer and soil treatments on the mineral content of food and forage plants indicated that the amounts of cobalt, manganese, molybdenum,

and other microelements in both hay and green vegetable crops are affected by liming and fertilization practices. On the basis of these results it seems possible that modification of liming and fertilization practices may result in an increased content of some of the essential microelements in soils.

Analysis of about 175 samples of common materials of plant origin have been made for cobalt and show: (1) that the leafy vegetables contain the most cobalt; (2) that different species of leafy food may vary in cobalt content although grown under the same conditions, and (3) that the same species may vary in cobalt content when grown in different localities.

Special Research Projects:

Part of the Special Research Fund (approximately 38 percent on the basis of the 1945 Budget estimates) is available to the Secretary of Agriculture for special research projects. This part of the fund is intended primarily to enable the Secretary to undertake studies which are basic to agriculture in its broadest aspects and which may be conducted by such agencies of the Department as he may designate or establish. The act requires that the research under this fund "shall be in addition to research provided for under existing law (but both activities shall be coordinated as far as possible)." There are many problems which arise, the solution of which requires research of fundamental character in order that further progress may be made. The fund enables the Secretary to undertake as far as possible such work as the need arises.

In administering, budgeting, and using the Special Research Fund, no money is allotted to the bureaus which conduct the research until carefully written project plans and cooperative arrangements are outlined in detail and approved by the Secretary. Allotments are adjusted on the basis of changes in relative needs of the projects which are under way.

Examples of Progress and Current Program: During the eight years that the Special Research Fund has been available, 95 separate research projects have been undertaken and 64, constituting 67 percent, have been terminated. Of those terminated, 37 were relatively short-time studies designed to provide information for immediate needs. Of the other 27 projects, 9 were terminated in 3 years, 6 in 4 years, 3 in 5 years, 4 in 6 years, 1 in 7 years, and 4 in 8 years. A total of 31 projects, involving 8 bureaus, are now under way.

The majority of these 31 projects are concerned with fields of work basic to agriculture in its broadest aspects. Many are supplying results especially valuable in the war effort. As the work progresses and as the needs vary, changes in emphasis are made from year to year. With the completion of work on one phase of a problem, the attack may be directed to another phase requiring solution.

The following are examples of progress made in special research projects during the fiscal year 1943:

Effect of faulty feeding on dairy cattle. Sterility, complete or partial, leading to curtailed productiveness in the dairy industry, is a source of great economic loss with domestic animals. The causes of sterility are many. In this phase of the study an attempt is being made to determine the role of nutritional factors.

It has been experimentally demonstrated that permanent injury to the vital pituitary gland frequently results from feeding young cattle rations that were inadequate in vitamin A content. Total blindness, due to constriction of the optic nerves, usually accompanies the pituitary injury. Apparently, however, this extreme visual defect is often a symptom of more severe vitamin A depletion than is the pituitary injury. Several animals killed at 18 months of age had been blind only a few days but the marked pituitary pathology indicated impairment of long standing.

An animal that became totally blind at 13 months of age, after 7 months on a ration extremely low in vitamin A, continued for some time to produce semen of good quality as judged by all known standards. Eventually the animal became very weak and attempts to collect motile semen were unsuccessful. The animal's strength, but not his eyesight, was restored following about 6 weeks of subcutaneous injections of 12 mg. of carotene per day. Semen samples were again collected but they were not of good quality. It is possible that the pituitary gland of this young animal has been irreparably injured but this cannot be determined until the animal is killed.

Economic Importance of Plants Used by American Indians. The American Indians had developed a fund of information concerning the usefulness of native plants which, admixed with ritual and myth, had been passed from generation to generation. This study was undertaken to separate fact from fancy in order to learn whether certain plants had constituents that were useful. The project is a cooperative undertaking between the Department and the University of Minnesota.

A substance, named nordihydroguaiaretic acid, was isolated from one reputed medicinal plant, the creosote bush, Larrea divaricata. The chemical structure indicated that the compound might be an antioxidant. The product, therefore, was tested for antioxidant properties in lard. Using the Swift test to determine stability the following results were obtained: ordinary lard had a stability of 3 - 6 hours, ordinary lard to which was added gum guaiac (a product now used to stabilize lard) had a stability of 16 hours, and lard to which the new compound was added at the rate of .1 percent had a stability of 400 hours.

Subsequently, tests were made of the antioxidant properties of nordihydroguaiaretic acid with lard in other laboratories and with other fats and oils. In every case it significantly increased the stability time of the material under test, but not to the same extent as was obtained in the original test. Incidentally, it should be pointed out that there is little available information concerning the meaning of the Swift stability values, especially above 50 to 75 hours.

Nordihydroguaiaretic acid is one of the most promising substances for increasing the stability of lard. This is particularly important to the Army because of the extreme conditions to which its foods are subjected. Naturally, it is essential that any products added to food must be free of toxic properties. Acute or short-time toxicity tests conducted with mice, guinea pigs, and rats indicated that the nordihydroguaiaretic acid was not toxic. Long-time ingestion of a substance may be harmful, even though no bad effects are evident over a short period. For this reason chronic tests to determine toxicity are now under way. These tests cannot be completed for some time, but to date there are no indications of toxic properties.

Patent applications on this material have been filed in the Patent Office.

Enzymes in Industry. Enzyme action when allowed to proceed uncontrolled may be very detrimental to agricultural products. On the other hand, under properly controlled conditions these actions may prove very beneficial to industrial agriculture. This investigation is to determine the methods of controlling and utilizing these changes.

In studying the production of alcohol from wheat it was found that one of the wheat proteins was a powerful yeast poison and was responsible for low yields of alcohol in some plants. It was discovered that either using more yeast in fermentation or thoroughly cooking the wheat mash before fermentation overcame this poisonous principle.

Investigations were made on the malting of wheat and the preservation of an extract of such malt, whereby diastase might be saved. These studies were without success. However, it was found that wheat contained as much

diastase before malting as barley does after malting. The diastase of wheat is insoluble in water and therefore useless unless it can be removed. This problem was solved by the discovery that much diastase could be extracted from wheat (even flour) by breaking down the proteins. This operation was performed by adding a little sodium sulphite and letting the proteinase naturally present in flour break down the flour proteins, liberating soluble diastase. When this principle was applied to alcohol production using wheat a yield of 5.4 proof gallons per bushel of very good alcohol was obtained. Application of the principle is being determined on a commercial scale. Present results indicate a savings of up to 10 percent in the cost of industrial alcohol from wheat, and up to 10 percent from corn. What is more important under present conditions is an increased output of about 2 percent from existing machinery.

The effect of Plant Hormones on Plant Tissues. The object of this investigation is to determine the possible applications and the limitations of use of plant hormones. These products, partly because of work under this project, are regularly used by nurserymen, orchardists, and other persons working with plants to produce certain desired reactions.

The commercial production of rubber-bearing plants requires a practical method for rapid vegetative reproduction. Growth-promoting substances such as indolebutyric acid, naphthalene-acetic acid, and naphthalene acetamide, when applied in talc dust or in water to stolons or stem cuttings of superior rubber-producing types of goldenrod, resulted in increased lengths and numbers of roots. Applications of the same substances to root cuttings of kok-saghyz (Russian dandelion) resulted in production of roots on a greater percentage of cuttings. With the latter plant, application of the substances in water was superior to that in talc dust. Indolebutyric acid produced longer and finer root systems in the early stages of rooting than did the other substances.

In cooperation with the Forest Service, several wound dressings containing growth substances for use in accelerating healing of tree wounds, have been found superior to standard dressings in that they actively promote wound healing. Emulsions containing lanolin and other substances applied to certain types of trees prior to transplanting result in lower percentage mortality of the transplanted material. Evidence has been obtained to show that application of growth-promoting substances to transplant material prolongs dormancy and thereby extends the time during which transplanting may be done.

Considerable success has been obtained in using plant hormones on woody plants to prevent drying out and to regulate growth rate. At the same time treatments have been made on intact and excised trees and branches for retention of foliage and development of desired reactions on photographic plates. Much of this work has to do with the development of improved methods of utilization of plant material for most effective camouflage and protective concealment.

The Nature of Cotton Bacterium Causing Industrial Disease. Complaints of illness in man resulting from the handling of stained cotton in various industries have come to both the Department of Agriculture and the Public Health Service. Prolonged investigations by the Public Health Service have traced such outbreaks to the presence of a particular species of bacterium in great numbers in and upon the cotton fibers in bales of cotton from certain gins in some cotton producing areas. This study was undertaken to determine the characteristics of the organism, the method and time of infection of the cotton, and the conditions that encourage the growth and multiplication of the organism.

Observations have shown that certain farming areas are more prone to produce cotton heavily contaminated with the bacterium than are other areas. Within such areas fiber harvested late in the season is more heavily contaminated than early-harvested fiber. In general the lower grades and shorter staple cottons were usually more heavily contaminated than cotton of higher market quality.

The contaminating bacterium was found widely distributed, but numerically insignificant, in soil and on green plant tissue. It was not found on seed cotton within unopened bolls. Injecting the organism into green, unopened bolls produced no pathological effects. On the other hand, the organisms were numerous on dead cotton bolls and on plant debris generally. When crop growing conditions are such that cotton bolls open rapidly and completely, and are normally mature at time of opening, contamination of the fiber was not noted. Fiber immature at time of killing frost and left in the field for several weeks thereafter showed sharp increases in contaminating populations, not shown by fiber mature at time of frost and left unharvested for similar periods. Prior to frost, fiber from bolls poorly opened and damaged by insect feeding or stinging showed heavier contamination than did fiber from fully opened, normally mature bolls.

Results to date show that the development of contaminated cotton in the field is dependent upon environmental factors and stage of boll maturity at opening and not upon any lack of inoculating material. It is also apparent that production of contaminated cotton will for the most part be limited to farming areas characterized by short growing season and comparatively low mean annual temperature, and within which an appreciable portion of the crop remains immature until time of frost.

Developing Sheep Suited to the Needs of the Navajo Indians. The Navajo Indians own the largest single group of low producing sheep in the United States. Improvement in the quality and quantity of both wool and mutton is important as a factor in the economic security of these Indians. This improvement is of added importance at this time because of the increased need for meat and wool in the present emergency. In order to attain these objectives the Department is cooperating with the Bureau of Indian Affairs, Department of the Interior, at a laboratory established by the latter at Fort Wingate, New Mexico.

Laboratory analysis of the fleeces of Navajo sheep in conjunction with hand weaving tests have shown conclusively that the amount of coarse hair and kemp fibers in the wool are dominant factors influencing its utility values. Improved methods have been developed for evaluating

the quality and clean wool yield of whole fleeces, from laboratory analyses of selected small samples. Through the use of these methods reliable fleece data are obtained on all progeny produced each year and are used as the principal basis for selection and breeding of the sheep.

The application of these results have brought about a marked improvement in the quantity and quality of wool produced per sheep. In 1942 the average fleece weights of the Navajo and crossbred ewes in the laboratory breeding flock were 6.0 and 7.7 pounds, respectively, compared to an average of 4.2 pounds for the original Navajo ewes in 1937. Owing to the high clean wool content of the fleeces, the 1942 production compared favorably with that of some purebred sheep. In addition, some of the sheep produced a type of wool which closely approached the desired objective.

Results of the laboratory breeding program are being put into practical use on the reservation. In 4 districts improved rams produced at the laboratory are being used on selected Navajo flocks to improve the quality of wool for hand-weaving. In the fall of 1942, a total of 39 rams and 70 ewes were made available for use on the reservation. The number and quality of such animals will be increased as fast as the facilities of the laboratory will permit.

The laboratory is also furnishing the Navajo Agency officials with technical assistance in the breeding, feeding, and management phases of their sheep improvement program. An essential part of this effort is the proper care and handling of the wool from the standpoint of the needs of native handicrafts as well as the commercial market.

The Relation of the Quality of Flue-Cured Tobacco to Mineral Nutrition. Flue-cured tobacco, constituting over 50 percent of the total tobacco production, is grown on comparatively infertile soils. Adequate fertilization is an important factor in the successful production of this crop. Although it is known that fertilization may greatly affect the yield and quality of tobacco, there is little specific information on the influence of the trace elements on the character of growth and development of the plant or on the factors of quality of the cured leaf. These problems are of particular importance at the present time because of the need of maximum output per acre and the necessity of using substitute fertilizer materials.

Three years' results of work, in cooperation with the South Carolina Agricultural Experiment Station, show that, at least for a limited period of years, there is little or no need of special provision for boron, copper,

manganese, or zinc in the tobacco fertilizer. Tests indicate that the application of 2.5 pounds of boron per acre has a definite toxic effect. The effect can be seen particularly during the early stages of growth of the plant and is reflected in a reduction in yield of nearly 15 percent. The maximum application of copper in these tests, 5 pounds, has shown a mild toxic action in the early stages of growth and has reduced the yield slightly. All other results of treatments show that the trace elements have no appreciable effect on the yield or value of tobacco.

Laboratory studies of the tobacco crop from the experimental plots supply the first reliable data on the actual quantities of trace elements required for producing a normal crop of tobacco of high quality on a typical light soil. Except when these elements are more liberally supplied in the fertilizer, the dry leaf contains only 15 to 30 parts per million of boron, copper, and zinc, and about 90 parts per million of manganese, while the dry stalks contain 10 to 15 parts per million of each. For a crop of 800 pounds of dry leaf and 400 pounds of stalks, the requirement on this basis would be less than a half ounce each of boron, copper, and zinc and somewhat more than an ounce of manganese per acre.

Substitute fertilizer materials were found to vary widely in the content of trace elements. Results in these studies have shown that a high potash application is decidedly beneficial to the tobacco crop. It was established that the sulphate form was the most satisfactory potash to use and domestic sources were as effective as the German sulphate formerly used. The results indicate that the desired action is due to the potassium and sulphur and not to trace elements as impurities.

These results are timely in the present emergency in that they furnish a valuable guide in the use of various substitutes for standard fertilizer materials.

The Effect of Light Upon Plant Growth and Development. Different daily durations of light and dark are known to cause pronounced variations in the growth and development of many kinds of crop plants. This investigation was undertaken to determine what reactions were responsible for the variations and to develop methods by which this behavior of plants can be utilized in more efficient crop production.

Seedlings of kok-saghyz, the rubber-producing dandelion, flowered slightly more abundantly under conditions of long daily duration of light than under conditions of short duration when grown in the greenhouse. The experiments indicate that the daily duration of light will not be markedly unfavorable to production of flowers and seed of this plant in any part of the United States. The conditions most favorable to early flowering appear to be long duration of light and relatively low temperature.

Rubber-bearing clones of goldenrod flowered earlier and produced more branches on 10-hour daily durations of light than on 13, 16, or 19-hour durations. Certain clones were earlier than others that received identical light treatments. Results of these experiments have suggested the desirability of making further selections of various species of goldenrod. They will also be significant if the production of this crop is to be moved into previously untested areas.

Two strains of hemp flowered earlier when the plants received short days than when they received long ones. This behavior of hemp will have a bearing on the selection of new areas for its production if the industry is to be expanded in the United States. The information will also enable breeders to speed up production of new strains and enable them to obtain a quick measure of the relative earliness of various progenies.

Studies with young onion seedlings revealed that those which bulb on a short day length are early types and those that bulb on a long day length are late types. This response makes it possible to distinguish early and late progenies and make selections while the seedlings are still small. By shortening the day length onion seedlings that have begun to form bulbs may be caused to grow continuously and flower without the usual time required for bulb formation. These results are of importance in a breeding and seed-production program with onions.

Investigations have shown that leaves in young stages of development are most sensitive in reaction to different daily durations of light and darkness. Physiological processes taking place during the dark period were found to be of primary importance in plant development, hence the marked effects from interrupting the dark period by short exposures to light of relatively low intensity. In applying this finding to Biloxi soybeans it was found that the production of flowers could be prevented under certain conditions by exposing plants to 1 to 15 minutes of light in the middle of the night.

Packaging of Cotton at Gins. The normal practice of handling ginned cotton has been to pack the lint cotton at the gins into bales of 500 pounds with a density of about 12 pounds per cubic foot. Cotton intended for storage, export, and long rail shipment was then shipped to compressors where the bale was repressed to a greater density, such as 22 pounds per cubic foot for "standard density" or 32 pounds for "high density." This procedure involves considerable rehandling and shipping and is responsible for a substantial part of the price spread between cotton growers and cotton manufacturers. In addition, numerous complaints have been registered for many years on the damage suffered by the bale package in compresses such as "air cuts," "non-uniform packing," and "excessive sampling." This investigation was undertaken to determine whether bales could be pressed to higher density at the gin, thus reducing labor for handling, space in storing and shipping, and injuries to the cotton in compressing.

The mechanical and economic feasibility of converting conventional single-ram low density up-packing gin presses into three-ram standard density presses has been definitely established for gins operating in the humid cotton-producing areas. Where all other conditions were similar, the pressing and tying out time were the same for a conventional low density press and for a converted standard density press. The power costs were 1.8 cents per bale higher for the standard density press. The standard density bales had only 65 percent of the volume of low density bales. This saving in space in railroad cars and warehouses is of major importance, especially under present conditions. Preliminary cost data show that for a gin plant having an annual volume of 2,000 bales, the installation of a standard density press would provide a net savings of about 45 cents per bale over the customary method of pressing to low density at the gin and then recompressing to standard density at a compress.

It has been established that the "dogs" which hold the cotton in place in the gin press box during the packing of bales are primarily responsible for the severe cutting of cotton bales during the process of compression. A new design of dog mechanism termed the "plate dog" has been developed as a result of this study, and a public patent has been applied for on the invention. Tests of the new dog mechanism have shown that bale cutting during compression is eliminated. In addition, waste of power in pressing non-uniformly packed bales is also largely eliminated by this device as it tends to distribute the cotton more evenly in the press box.

Various types of bale ties and buckles were tested in an effort to provide a light-weight tie that would give satisfactory performance for use with the more resilient narrow-width, standard density bale. It was found that regular 2-pound ties may be successfully used by making a fold on the end so as to provide a double thickness for reinforcement where the tie engages the buckle. This method prevents shearing in the opening of the arrow buckle.

In spinning tests cotton from gin-compressed bales handled equally as well as the compressed standard density bales.

Preserving Agricultural Materials in as Nearly a Natural Condition as Possible. This study was undertaken to develop methods of preserving the color and natural properties of plant and other agricultural specimens in the original state to meet the need of biological research workers. The data obtained in this work have proved to be valuable in preparing vegetation for camouflage purposes, and in providing basic knowledge for investigations to extend the usefulness of protective coverings to meet war needs.

Results obtained in this investigation have indicated that all organic solvents, used in an effort to stabilize leaf pigmentation, have a detrimental effect upon color in preserved foliage when exposed to direct sunlight. Certain classes of solvents had a much more pronounced effect than others, the terpenes and aliphatic hydrocarbons appearing to be the least detrimental. Of 15 preservative formulas tested, 2 showed marked superiority in resisting the effects of direct sunlight both with and without solvent after-treatment. Protective coatings of glass and highly water-resistant plastic resins, applied in thicknesses of 0.025 inches and over, have prolonged the retention of natural color for at least 2 months in certain leaf specimens treated with the two most effective preservative formulas. When thinner coatings were tried, or the coatings were made of material less impervious to water, the length of time the natural color was retained was generally of the order of 2 to 4 days.

Experiments were conducted on developing methods for preparing and utilizing crude adhesive materials from natural sources for meeting emergency camouflage needs where base supplies are unavailable. Materials obtainable from green vegetation, sturdy plant material, and marine algae were tested and some preliminary work was done on the utilization of natural gums and resins. The results of this work form the basis for instructions issued by the military services.

Administration of payments to States under Title I, Bankhead-Jones Act:

The administration of the payments authorized by the Bankhead-Jones Act differs from administration of the other acts providing federal grants for agricultural experiment stations (Hatch, Adams, and Purnell Acts discussed under the Office of Experiment Stations) on a number of points, including the following:

(1) The Bankhead-Jones allotments may not be made to any State, Territory, or Puerto Rico unless offset by at least an equal amount of non-Federal funds for research and facilities for research. This requires the review of the work and expenditures under \$2,400,000 offset funds as well as those under \$2,400,000 Bankhead-Jones Federal-grant funds.

(2) The Bankhead-Jones funds for the State agricultural experiment stations are apportioned primarily on the basis of rural population. The Federal-grant funds of these stations provided by previous Acts are on the basis of an equal amount for each State.

(3) As a part of their research offset, the States, Territories, and Puerto Rico may include expenditures during the year for physical plant and equipment necessary for the prosecution of research. This provision requires administrative responsibility to ascertain that expenditures for physical plant and equipment advanced for offset credit are for research purposes.

(4) Under the terms of the Bankhead-Jones Act the funds authorized by the Act may be used for physical plant, including the purchase and rental of land and construction of buildings and for the equipment and maintenance of such buildings without limitation as to the portion of the funds which may be used for these purposes. The expenditures, however, must be limited to those necessary for the research under this Act. It is an administrative responsibility, therefore, to approve such expenditures only in relation to the specific needs of the work conducted under the Bankhead-Jones grant funds.

Examples of Current Activities: During the fiscal year 1943, the administration of the provisions of Title I of the Bankhead-Jones Act of June 29, 1935, which authorized payments for agricultural experiment stations, involved:

(1) Critical examination and approval, in advance of the expenditure of funds, of research projects, there being 1,199 active Bankhead-Jones projects during the fiscal year, of which 271 were either new or revised. This represents an increase in the total number of active projects and an increase in the number of new and revised projects over the previous fiscal year, caused largely by the effort on the part of the agricultural experiment stations to redirect their research activities toward work of more vital importance to the war effort. The respective figures for 1942 were 1,145 active projects and 247 new and revised projects.

- (2) Review in the fields of the work and expenditures at the State agricultural experiment stations under funds totaling \$2,463,708 provided under Title I of the Bankhead-Jones Act and apportioned primarily on the basis of rural population.
- (3) Review in the field of research and research facilities of the stations supported by \$2,463,708 from non-Federal sources advanced as offset credit to meet the requirements of Section 5 of the Bankhead-Jones Act.
- (4) Special examination of any expenditures from the allotments under the Bankhead-Jones Act made for the construction, equipment, and maintenance of buildings and purchase and rental of land to ascertain that such expenditures were necessary for the research supported by the funds provided by the Bankhead-Jones Act.
- (5) Assisting in coordinating the research under this Federal-grant fund between the State stations and with the research of the Department, and maintaining advisory relations with the State stations on technical and administrative matters pertaining to their research programs and station organization.
- (6) Reporting to the Secretary and the Congress on the work and expenditures under this Federal-grant fund.

Specific examples of the type of work done under this project are given in the statement for the Office of Experiment Stations under the appropriation "Payments to States, Hawaii, Alaska, and Puerto Rico for Agricultural Experiment Stations" and under the subappropriation "Administration of grants and coordination of research with States." This Office administers the payments to States authorized by Title I of the Bankhead-Jones Act as well as the payments to State agricultural experiment stations authorized by other acts.

PASSENGER-CARRYING VEHICLES

The estimate for the purchase of passenger-carrying vehicles for the Special Research Fund, Department of Agriculture contemplates an increase of \$1,100 (nothing in 1944, \$1,100 estimated for 1945) for this purpose. The total estimate of \$3,700 will permit (a) the operation and maintenance of 12 and (b) the replacement of 1 vehicle, or approximately 8 percent of the total fleet, at a net cost of \$1,100 when exchange allowances are taken into account. No funds are requested for the purchase of additional vehicles.

Experience has shown that in normal times when there is no shortage of new cars it is more economical to trade in about 25 percent of the total fleet, with an average age of about four years and performance of around 40,000 miles. In view of the emergency condition, however, it is proposed that

only one automobile be traded in during 1945. It is hoped that the present intensified program of upkeep, as well as restricted use of vehicles now in operation, will permit the maintenance of automobiles of a greater average age during the emergency.

The passenger-carrying automobile to be replaced is used at the Sheep Breeding Laboratory, Dubois, Idaho, to carry the technical staff over extremely rough trails studded with protruding imbedded lava rock, and with sage brush growing between the wheel tracks. The car has to be used in all kinds of weather. There is heavy snow and much drifting in the winter and most of the roads cannot be kept clear. The area of this station is too large to warrant travel by horseback. Present indications are that by 1945 the car will have reached the point where it can no longer be operated economically. It is, furthermore, extremely doubtful that by that time the car can be depended upon to cover the long distances involved without a breakdown which might mean that employees would be stranded many miles from any contact. In a severe snowstorm this might be fatal.

AGRICULTURAL RESEARCH ADMINISTRATION

Office of Experiment Stations

(a) Payments to States, Hawaii, Alaska, and Puerto Rico

Appropriation Act, 1944	\$7,001,208
Budget estimate, 1945	<u>6,937,500</u>
Decrease	<u>-63,708</u>

PROJECT STATEMENT

Project	: 1943	: 1944	: 1945	: Increase or
	:	:(estimated):	:(estimated):	decrease
1.Hatch Act (March 2, 1887) :	\$720,000:	\$720,000:	\$720,000:	--
2.Adams Act (March 16, 1906):	720,000:	720,000:	720,000:	--
3.Purnell Act (February 24, :	:	:	:	:
1925)	2,880,000:	2,880,000:	2,880,000:	--
4.Hawaii Station Act (May 16, :	:	:	:	:
1928	67,500:	90,000:	90,000:	--
5.Alaska Station Act	:	:	:	:
(February 23, 1929)	15,000:	15,000:	15,000:	--
6.Alaska Station Act	:	:	:	:
(June 20, 1936)	10,000:	22,500:	22,500:	--
7.Puerto Rico Station Act	:	:	:	:
(March 4, 1931)	50,000:	90,000:	90,000:	--
8.Bankhead-Jones Act,	:	:	:	:
Title I (June 29, 1935) ...:	2,463,708:	2,463,708:	2,400,000:	-63,708 (1)
Total estimate or	:	:	:	:
appropriation	6,926,208:	7,001,208:	6,937,500:	

DECREASE

- (1) A decrease of \$63,708 under Project 8, Bankhead-Jones Act, Title I (June 29, 1935).

The item of \$63,708 was first included under a proviso in the appropriation act for the fiscal year 1942 in order to prevent reductions in allotments to States because of changes in relative rural population, as shown by the 1940 census. Since the apportionment of funds covered by the proviso is not in accordance with the authorizing act, the estimate eliminates the \$63,708.

CHANGES IN LANGUAGE

The changes in language in each of the several items covering payments to States, Hawaii, Alaska, and Puerto Rico, for agricultural experiment stations, are for the purpose of clarifying the existing language through simplification and the deletion of surplusage and do not in any way contemplate changes in existing authorizations, with the following exception:

The following proviso is deleted from the language making funds available under Title I, Bankhead-Jones Act of June 29, 1935:

Provided, That in order to prevent reduced allotments because of changes in relative rural population, \$63,708 of this appropriation shall be available for allotment during this fiscal year in the same amounts and to the same States and Territory which received allotments from this appropriation in the fiscal year 1942.

Deletion of this proviso is provided in order that the estimates and the consequent allotments will conform with the provisions of the authorizing legislation.

WORK UNDER THIS APPROPRIATION

General: The several appropriations under "Payments to States, Hawaii, Alaska, and Puerto Rico" represent the Federal Government's support to the State, Territorial, and Puerto Rican agricultural experiment stations which were established as departments of the land-grant colleges pursuant to the provisions of the Hatch Act of 1887.

The objective and duty of the State agricultural experiment stations is to conduct researches and experiments along the lines authorized by the several Federal-grant fund acts and the complementary acts of the States on the many problems constantly encountered in the development of a permanent and sustaining agriculture, and ~~in the~~ improvement of the economic and social welfare of the farm family, with emphasis at present on the solution of problems arising as a result of wartime conditions.

In addition to their function of serving State and local needs, the research programs of the State stations, to be most effective, include participation in regional and national programs. Since the economic and social welfare of the rural population and the general consumer public of a State is definitely affected by, and related to, the welfare of the population of other States, joint attack by a group of State stations is the most effective and often the only practical approach to problems of common interest.

The research programs of the State agricultural experiment stations and the United States Department of Agriculture are supplementary and interdependent. The Department of Agriculture, having primary responsibility to improve agriculture and the rural home for the whole country, approaches agricultural problems from the regional and national viewpoint, but without losing sight of the fact that the individual farm and farm family is the fundamental unit of American agriculture. A large part of the research work of the State stations and the Department is conducted on an

actively cooperative basis to use all available resources to the best advantage. The State agricultural experiment stations, for example, look to the Department of Agriculture for leadership in the solution of regional and national problems, for synthesizing the results of related research, and for assistance in attacking new problems of potential regional or national significance. The Department, on the other hand, depends upon the State agricultural experiment stations for bringing to bear upon problems an intimate knowledge of local conditions and adapting the general conclusions or developments of the Department and broadly cooperative research to the varying conditions of the individual States.

Financial Support: The Federal-grant funds for the State agricultural experiment stations are authorized by the Hatch Act of March 2, 1887, the Adams Act of March 16, 1906, the Purnell Act of February 24, 1925, Title I of the Bankhead-Jones Act of June 29, 1935 and the Acts extending the benefits of the Hatch, Adams, and Purnell Acts to Hawaii, Alaska, and Puerto Rico. As the same stations receive benefits from each of these Acts and the funds are used for the same general purpose, the explanatory notes covering these funds are treated as a unit to avoid repetition of the various statements which apply to each of the funds.

The several appropriations under "Payments to States, Hawaii, Alaska, and Puerto Rico" provide annually for each State or Territorial agricultural experiment station, except Alaska, \$15,000 under the Hatch Act of March 2, 1887; \$15,000 under the Adams Act of March 16, 1906; \$60,000 under the Purnell Act of February 24, 1925; and for the fiscal year 1944, \$2,463,708 under the Bankhead-Jones Act of June 29, 1935, to the States, Territories, and Puerto Rico, apportioned primarily on the basis of rural population. The Alaska Station receives \$15,000 under the Hatch Act, \$7,500 under the Adams Act and, in 1944, received \$15,000 under the Purnell Act.

For payments to the States, Hawaii, Alaska, and Puerto Rico, for agricultural experiment stations, Title I of the Bankhead-Jones Act of June 29, 1935, authorizes the following appropriations to be apportioned on the basis of rural population: Fiscal year 1936, \$600,000; fiscal year 1937, \$1,200,000; fiscal year 1938, \$1,800,000; fiscal year 1939, \$2,400,000; fiscal year 1940 and thereafter, \$3,000,000. Beginning with the fiscal year 1939, the full amounts have not been appropriated. The allotments under this Act, as appropriated to each State, Hawaii, Alaska, and Puerto Rico, in the fiscal years 1942, 1943, and 1944, and as estimated for 1945, are shown in Table I, which follows.

TABLE I

Allotments to States Under Bankhead-Jones Act of June 29, 1935, Title I
as Appropriated 1942, 1943, and 1944, and Budget Estimate 1945

State	: Appropriated 1942, 1943, : :and 1944 (Basis 1940 rural: :population and provisos in: : Appropriation Acts) :	Estimated 1945 (Basis 1940 rural population)
Alabama	\$82,695.12	* \$80,745.88
Alaska	2,252.44	2,252.44
Arizona	13,285.16	13,285.16
Arkansas	63,983.20	* 61,977.12
California	81,893.64	81,893.64
Colorado	22,430.96	* 21,750.12
Connecticut	22,507.32	22,507.32
Delaware	5,189.96	5,189.96
Florida	34,782.16	34,782.16
Georgia	87,522.92	* 83,723.08
Hawaii	9,186.40	* 6,497.96
Idaho	14,219.84	14,219.84
Illinois	86,736.52	* 85,261.84
Indiana	62,900.44	62,900.44
Iowa	64,854.64	* 59,386.08
Kansas	50,050.96	* 42,765.36
Kentucky	81,533.32	81,533.32
Louisiana	56,502.80	56,502.80
Maine	20,692.16	* 20,591.40
Maryland	30,259.72	30,259.72
Massachusetts	18,674.92	18,674.92
Michigan	73,566.60	73,566.60
Minnesota	57,269.04	57,269.04
Mississippi	72,651.40	* 71,511.20
Missouri	76,967.80	* 74,494.92
Montana	15,503.16	* 14,209.88
Nebraska	38,776.60	* 32,742.64
Nevada	2,734.64	2,734.64
New Hampshire	8,507.40	8,507.40
New Jersey	31,260.32	31,260.32
New Mexico	14,516.00	14,516.00
New York	94,478.24	94,478.24
North Carolina	106,085.56	106,085.56
North Dakota	24,675.76	* 20,830.04
Ohio	93,717.64	93,717.64

TABLE I--Continued

State	: Appropriated 1942, 1943, and 1944 (Basis 1940 rural population and provispos. in: Appropriation Acts)	: Estimated 1945 (Basis 1940 rural population)
Oklahoma	\$68,450.84	* \$59,497.76
Oregon	22,790.32	22,790.32
Pennsylvania	135,322.64	135,322.64
Puerto Rico	53,213.24	53,213.24
Rhode Island	2,449.04	2,449.04
South Carolina	59,464.96	* 58,555.20
South Dakota	24,432.44	* 19,803.32
Tennessee	77,136.04	77,136.04
Texas	149,364.76	* 143,088.08
Utah	10,503.68	* 9,998.88
Vermont	10,471.60	* 9,638.44
Virginia	71,144.56	* 70,783.56
Washington	33,254.64	33,254.64
West Virginia	55,859.16	55,859.16
Wisconsin	60,224.88	* 59,566.04
Wyoming	6,759.52	* 6,418.96
Total	2,463,707.08	2,400,000.00

* Indicates those States for which reductions in allotments are contemplated by the Budget estimates due to a budget decrease of \$63,708 below the 1944 appropriation.

The only Federal-grant fund act which requires offsetting on the part of the States is the Bankhead-Jones Act; under Title I of which the States are required to provide contributions equal to the amounts of the Federal payments. Although none of the other Federal-grant fund acts include an offsetting requirement, the States have been contributing, on the average, more than \$2.00 to the support of their agricultural experiment stations to each \$1.00 of all Federal-grant funds received for agricultural research.

The amounts of Federal-grant fund allotments and income from State sources of each of the State, territorial, and Puerto Rican agricultural experiment stations for the fiscal year 1943 are shown in Table II.

TABLE II--Income of Stations, Fiscal Year 1943

Station	Federal	Non-Federal	Total
Alabama	\$172,695.12	\$607,829.82	\$780,524.94
Alaska	27,252.44	30,906.07	58,158.51
Arizona	103,285.16	143,730.55	247,015.71
Arkansas	153,983.20	227,516.20	381,499.40
California	171,893.64	1,370,334.12	1,542,227.76
Colorado	112,430.96	236,905.22	349,336.18
Connecticut, State	56,253.66	152,465.09	208,718.75
Connecticut, Storrs	56,253.66	91,785.31	148,038.97
Delaware	95,189.96	89,044.50	184,234.46
Florida	124,782.16	819,461.13	944,243.29
Georgia	177,522.92	124,250.10	301,773.02
Hawaii	76,686.40	144,497.95	221,184.35
Idaho	104,219.84	84,846.83	189,066.67
Illinois	176,736.52	561,274.50	738,011.02
Indiana	152,900.44	873,289.82	1,026,190.26
Iowa	154,854.64	497,626.77	652,481.41
Kansas	140,050.96	298,202.50	438,253.46
Kentucky	171,533.32	431,138.45	602,671.77
Louisiana	146,502.80	240,110.22	386,613.02
Maine	110,692.16	113,778.12	224,470.28
Maryland	120,259.72	210,007.92	330,267.64
Massachusetts	108,674.92	146,905.81	255,580.73
Michigan	163,566.60	276,420.41	439,987.01
Minnesota	147,269.04	457,411.50	604,680.54
Mississippi	162,651.40	361,430.29	524,081.69
Missouri	166,967.80	246,392.02	413,359.82
Montana	105,503.16	220,881.59	326,384.75
Nebraska	128,776.60	229,404.02	358,180.62
Nevada	92,734.64	26,410.81	119,145.45
New Hampshire	98,507.40	26,979.82	125,487.22
New Jersey	121,260.32	562,092.27	683,352.59
New Mexico	104,516.00	106,969.79	211,485.79
New York, Cornell	166,030.40	823,038.71	989,069.11
New York, State	18,447.84	388,469.76	406,917.60
North Carolina	196,085.56	201,428.49	397,514.05
North Dakota	114,675.76	118,671.95	233,347.71
Ohio	183,717.64	1,482,027.19	1,665,744.83
Oklahoma	158,450.84	375,127.16	533,578.00
Oregon	112,790.32	382,030.44	494,820.76
Pennsylvania	225,322.64	254,846.80	480,169.44
Puerto Rico	103,213.24	210,479.50	313,692.74
Rhode Island	92,449.04	16,555.52	109,004.56
South Carolina	149,464.96	328,785.62	478,250.58
South Dakota	114,432.44	104,553.94	218,986.38
Tennessee	167,136.04	126,353.87	293,489.91
Texas	239,364.76	966,817.24	1,206,182.00
Utah	100,503.68	85,958.64	186,462.32
Vermont	100,471.60	10,186.07	110,657.67
Virginia	161,144.56	146,469.89	307,614.45
Washington	123,254.64	292,421.97	415,676.61
West Virginia	145,859.16	173,500.18	319,359.34
Wisconsin	150,224.88	667,440.00	817,664.88
Wyoming	96,759.52	112,204.02	208,963.54
Total	6,926,207.08	17,277,666.48	24,203,873.56

Examples of Progress and Current Program: The State stations are in a strategic position to aid in record production of food required and in local adjustments arising out of changing conditions of wartime. This is because of location, intimate knowledge of the varied conditions within the respective States and regions, essential facts and technical knowledge and experience acquired over years, established relationships with producers and with other agencies of the State and the Federal Department of Agriculture. Accordingly, responsibility as well as the opportunity of these stations for effective service are greatly increased by wartime demands.

Among the major emergency problems requiring new and accelerated study by the stations and the assembly and interpretation of existing facts are those involving (a) an increase in the amounts of foods produced for human consumption, including foods required by our armed forces and lend-lease; and (b) the replacement of essential agricultural products formerly imported.

In addition, new and accelerated study by the stations is directed:

(1) To problems of increasing feed for livestock to make possible the increase in animal products and especially to make maximum use of pasture and roughages and to provide substitutes for feedstuffs which are in limited supply.

(2) To problems of processing foods to reduce bulk and facilitate transportation, including methods for conserving nutritional values and palatability.

(3) To problems of developing and maintaining adequate standards of nutrition, including more knowledge of nutritive values of foods.

(4) To problems of adjustments involved in demands for increased production and restriction of production facilities, and those involved in changing market situations, and shifts in transportation problems.

The large volume and increasing number of requests received by the stations for information and direction on problems, within the respective States, arising out of the war emergency are illustrated by the following example covering only a part of the activities of one station of average size. For the quarter ended September 30, 1942, the station report showed that in meeting requests for such assistance members of the staff replied to 9,208 letters, answered 4,710 telephone calls, received 2,580 personal visits, gave 82 addresses and 23 radio talks, held 711 conferences outside the station offices, and distributed 2,935 mimeographed circulars and 1,192 mimeographed letters pertaining to food production and the war effort. Special publications were prepared giving available information and directions as to the possibility of expanding pork production in the Wheat Belt by substituting wheat for corn, and on soybean production and harvesting. When this obviously heavy load superimposed on the research work of the staff of

one station is extended to include the similar demands on stations in the 48 States and in the Territories, it all foots up to a tremendous total of high importance to the war effort. Since the foregoing records were made the Victory Garden activity has added a large number of new clients calling for information and directions, without which the large Victory Garden production would not have been attained.

So far as possible the stations have met increasing demands for aid on some of the more critical problems tending to restrict production of needed food supplies by undertaking new research projects and by assembling existing and new information and issuing news releases, short "victory" series circulars, or other types of statements in which brevity, practical usefulness, and timeliness are major considerations. Typical of the calls upon the stations for such information is a report from one of the Mountain States that during the 12-months period ended October 1, 1942, individual requests received by the station required a total of 30,856 copies of its publications.

The adjustment of research programs to the war effort by the stations reported for the fiscal year 1942, continued at the same high level in 1943 with the redirection of work where needed to meet the most urgent demands of the changing food situation. Adjustments during 1942 involved the undertaking of 821 new and revised projects under the Federal-grant funds in a program involving a total of 3,472 projects--an increase of 55 percent in adjustment of work and of 16 percent in volume over the average of the five preceding years. The continuing adjustment during 1943 resulted in the undertaking of 724 additional new and revised projects in a program involving a total of 3,419 projects.

Participation by the stations with the Department and other agencies in programs of national and regional scope has included among others:

- (1) Cooperative work by all stations in a national study of maximum wartime productive capacities of States and regions undertaken to supply basic information needed for setting up 1944 production goals.
- (2) Providing technical advice and information needed locally and nationally on such subjects as availability of and requirements for agricultural labor, supplies, farm machinery, fertilizers, and spray materials; problems relating to transportation of farm products and supplies; costs of producing various crops in relation to incentive payments and price ceilings and effects of rationing on production.
- (3) Investigations relating to nutritive properties of more than 60 different foods by 44 stations under a National Cooperative Project on Conservation of Nutritive Value of Foods.
- (4) Studies by 27 stations on the vitamin A content of commercial supplies of butter as a part of a National Cooperative project.

(5) Action by regions on problems of common concern to groups of States, such as, for example, (a) the conference of representatives of State stations and extension services as to probable supply of vegetable protein meals for livestock feeding in Southern States in 1942-1943 and the best ways to utilize these supplies, (b) the regional study undertaken simultaneously by 14 Corn Belt stations in cooperation with the Bureau of Agricultural Economics on the marketing of livestock and livestock products, and (c) the joint action by several Southern State stations and the Tennessee Valley Authority on the design of a dehydrator suitable for use in farm and city homes for dehydrating fruits and vegetables.

The stations have continued investigations on special problems at the request of the armed forces and have helped with advice and assistance, as, for example, in Florida where detailed study of 11 air bases was made by the station relative to problems in the establishment and maintenance of turf.

A considerable amount of information dealing with the research programs, results, and services of the agricultural experiment stations has been assembled during the year and released to the directors and administrative officers of the Department in the form of mimeographed quarterly reports. Copies of these reports are available, if desired, for the record or for review.

(b) Administration of Grants and Coordination of Research with States

Appropriation Act, 1944	\$156,010
Anticipated deficiency for overtime pay required	
by the War Overtime Pay Act of 1943	+20,159
Total anticipated available, 1944	176,169
Budget estimate, 1945	<u>176,169</u>

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Administration of Federal:	:	:	:	:
grant funds for State and :	:	:	:	:
Territorial agricultural :	:	:	:	:
experiment stations; co- :	:	:	:	:
ordination of research :	:	:	:	:
work of the State and Ter- :	:	:	:	:
ritorial stations, and co- :	:	:	:	:
ordination of this research:	:	:	:	:
with that of the Department:	:	:	:	:
and administration of De- :	:	:	:	:
partment insular stations :	\$157,738:	\$176,169:	\$176,169:	- -
Covered into Treasury in ac- :	:	:	:	:
cordance with Public Law :	:	:	:	:
674	+145:	- -:	- -:	- -

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
Transfer to "Salaries and ex- penses, Office of Experiment: Stations, Federal Experiment: Station in Puerto Rico" ...	+\$4,000:	--:	--:	--
Unobligated balance	875:	--:	--:	--
Total available	162,758:	\$176,169:	\$176,169:	--
Transfer to "Salaries and ex- penses, library"	+9,750:	:	:	:
Anticipated deficiency for overtime pay	--:	-20,159:	--:	:
Total estimate or appropriation	172,508:	156,010:	176,169:	:

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	*\$2,046:	\$3,043:	\$2,730
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	6,603:	20,159:	20,159
Total cost of overtime (7 months in 1943)	8,649:	23,202:	22,889

*Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: (a) To represent the Department in the administration of the Acts of Congress making appropriations for the support of State and Territorial agricultural experiment stations in the several States, Hawaii, Alaska, and Puerto Rico (Hatch, Adams, and Purnell Acts, and the Hawaii, Alaska, and Puerto Rico Station Acts); and (b) to administer the Federal Agricultural Experiment Station in Puerto Rico.

Plan of Work: Administration of the Acts granting funds to States and Territories involves supervision of the funds, close advisory relations with the stations as to research for which the funds are expended, annual examination of the work and expenditures of each station, assistance to the State stations in working out programs for cooperative effort to avoid duplication, and assistance to Federal agencies in working out cooperation with the States, and preparation of the annual report to Congress on the work and expenditures of the stations, as required by law.

The Federal funds paid to the States and Territories are largely expended on research projects submitted to the Office of Experiment Stations for advisory suggestions and approval in advance of expenditures. Programs of projects with proposed expenditures under the Federal funds are submitted by each station for review and approval at the beginning of each fiscal year. Changes and adjustments in work to best meet State needs are submitted throughout the year.

To carry out the provisions of the Federal Acts, a representative, or representatives, of the Office visits each of the 50 State stations at least once annually and spends four to twenty-one days reviewing the expenditures and the research under way. In addition, staff members cooperate as specialists with individual stations and regional groups in the development and adjustment of research programs for special fields.

As explained under the heading "Special Research Fund, Department of Agriculture," the Office also has the responsibility for the administration of the payments to States authorized by Title I of the Bankhead-Jones Act of June 29, 1935, and the explanatory notes relative to work and expenditures hereunder apply also to grants under Title I of the Bankhead-Jones Act.

Early in the calendar year 1941, the Office of Experiment Stations began to advise with the State agricultural experiment stations on adjustments in their research programs to concentrate on research activities most needed immediately because of war demands. Since that time, there has been a constant and continuing effort on the part of this Office to so aid the stations as to permit maximum accomplishment in solution of local problems and those of regional and national importance. This shift of activities to problems of immediate significance is evidenced by the fact that a total of 571 research projects were discontinued while 498 new projects were undertaken and 226 projects were revised during the fiscal year 1943. The stations undertook a total of 3,419 studies during 1943. Each of the changes in projects indicated and each project continued without change was reviewed during the year by the staff of this Office as to intent and adequacy. In any problem of more than local interest, this review included ascertainment that the research dovetailed with work being conducted at other State stations or by other agencies so as to avoid duplication of effort and to promote accurate research results through cooperation and joint attack on problems extended beyond the borders of any one State. That such cooperation is real and effective is plainly indicated by the more than 1,200 formal cooperative agreements and memoranda of understanding in effect during the past year between State stations and between State stations and other agencies. Each of these formal documents was approved by the Office of Experiment Stations before becoming operative.

As indicated in the statement under the Federal station in Puerto Rico, the research program has been aimed at participation in the important problems of securing strategic materials, especially insecticides and quinine; at assistance in the urgent problem of increasing food production in Puerto Rico; and at aiding the armed forces in Puerto Rico through making available planting materials not readily available from any other sources.

In addition, the emergency workload of the Office has greatly increased in three important respects: (a) in arranging for assistance from the State stations to Federal agencies and others; (b) in furnishing information and assistance to the State experiment stations to avoid, insofar as possible, travel to Washington or to other States; and (c) participation in national programs.

(a) Examples of Assistance from State Stations to Federal Agencies and Others:

1. The Bureau of Agricultural Economics, in cooperation with representatives of the Agricultural Research Administration, undertook a study of wartime production capacity to furnish basic information for the 1944 production goals program. The cooperation of the State agricultural experiment stations, because of their thorough knowledge of local production capacities and facilities was essential. The necessary cooperation from the State stations was arranged promptly by this Office.
2. On April 15, 1943, the Department announced the price-supporting loan program on twenty kinds of hay and pasture seeds. The War Food Administration needed a list, by name of variety, giving the estimated 1943 production of each variety or strain of seeds which would be recognized for certification. This information was secured promptly from the various State agricultural experiment stations through this Office.
3. The Food Distribution Administration in February needed information as to work which had been done at the agricultural experiment stations of the South on the production of ramie. In addition to assembling published information, specific information was secured within a month from the experiment station directors in the Southern States.
4. Early in the year the Office received a request from the Food Distribution Administration for seed suitable for production under tropical conditions, particularly seed of sweet corn, soybeans, and cucumbers. Arrangements were made by this Office with both the Federal and Territorial experiment stations in Puerto Rico for making available seed supplies of these crops to the Food Distribution Administration.
5. On numerous occasions throughout the year the Office has been called upon to furnish assistance to foreign agriculturists from China, India, Russia, and Latin American countries either by securing information desired by them on particular subjects or by arranging for their visiting the State agricultural experiment stations to study specific problems.

6. Cooperative assistance along the above lines in some form is almost a daily additional workload.

(b) Examples of Information and Assistance Furnished to State Agricultural Experiment Stations:

1. When butter was rationed, all stations cooperating in the national cooperative project on vitamin A content of butter were faced with the problem of securing sufficient butter samples to continue research work already under way. Complete information as to procedure to be followed was secured and made available promptly to the stations to permit continuation of this research.

2. Research workers at the Cornell Experiment Station developed the fact that yam beans contained rotenone or rotenoids useful in the preparation of insecticides. To enable further research this Office arranged for the shipment of yam beans from China to the United States. The Office also secured all information available from other bureaus of the Department pertaining to the subject to assist in this research at the Cornell Station and arranged for conference with Departmental officials in the interest of timely joint effort.

3. A great deal of attention has been centered on dehydration as a process of preserving foods. Many of the State stations have been conducting research on this problem. This Office has acted as a clearing house for information on this important subject between the State stations and between the stations and the Department. The Office also has assisted in securing the approval for the production of 100,000 home dehydrators, the plans and specifications for which were prepared by a group of nine southern State agricultural experiment stations cooperating with T.V.A. and agricultural Extension Services and other agencies.

4. The Office continues to supervise the use of Preference Rating Order No. P-43, Serial No. 2, which was secured from the War Production Board for use by the State agricultural experiment stations. This preference rating order grants a high priority rating to enable the State stations to secure supplies and equipment necessary in the conduct of research. It has unquestionably saved the stations much time and effort. In addition, the Office receives innumerable calls for assistance regarding priority problems both from the State stations and from the War Production Board regarding applications submitted by the State stations for equipment.

(c) Participation in National Programs:

1. In 1941, the Committee on Food and Nutrition of the National Research Council, recommended that the State agricultural experiment stations and the Department of Agriculture undertake to determine whether butter in the usual trade channels can be depended upon to furnish a uniform supply of vitamin A and in what amount. This Office secured the cooperation of the State stations located in the dairy States. At present 27 States

are actively participating in the national study of this important problem. The Office is assisting them through clearing questions as to equipment, supplies, material, factual information, and cooperation among States and with Federal agencies.

2. The Committee on Food and Nutrition of the National Research Council recommended also that the State agricultural experiment stations, with cooperation from the Department, undertake a national study on the conservation of the nutritive values of foods in processing, marketing, storage, and cooking. This study is very complex inasmuch as 44 stations are participating in securing information on over 60 different foods. The information being developed is much in demand by the Office of the Surgeon General and the Office of the Quartermaster General of the Army, and by the Subsistence Branch of the Navy, as well as by both public and private institutions. The Chief of the Office, by request, is acting as coordinator in the planning and organization of this national effort.

(c) Federal Experiment Station, Puerto Rico

Appropriation Act, 1944	\$100,000
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+7,074
Total anticipated available, 1944	107,074
Budget estimate, 1945	<u>107,074</u>

PROJECT STATEMENT

Project	: 1943	: 1944	: 1945	: Increase or
		:(estimated):	:(estimated):	decrease
1. Federal Experiment Sta-	:	:	:	:
tion in Puerto Rico	:\$96,444:	\$107,074:	\$107,074:	--
Covered into Treasury in	:	:	:	:
accordance with Public	:	:	:	:
Law 674	+300:	--:	--:	--
Transfer from "Salaries and	:	:	:	:
expenses, Office of Exper-	:	:	:	:
iment Stations, Adminis-	:	:	:	:
tration of grants and co-	:	:	:	:
ordination of research	:	:	:	:
with States"	-4,000:	--:	--:	--
Unobligated balance	+1,745:	--:	--:	--
Total available	94,489:	-107,074:	107,074:	
Anticipated deficiency for	:	:	:	:
overtime pay	--:	-7,074:	--:	
Total estimate or	:	:	:	:
appropriation	94,489:	100,000:	107,074:	

CHANGE IN LANGUAGE

Inasmuch as the Federal Experiment Station in Puerto Rico is now the only Station which the Office of Experiment Stations administers directly, it is recommended that the subappropriation title be changed from "Insular Experiment Stations" to "Federal Experiment Station, Puerto Rico."

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	*\$55:	\$1,005:	\$1,079
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	3,897:	7,074:	7,074
Total cost of overtime (7 months in 1943) ..	3,952:	8,079:	8,153

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To conduct research investigations with a view to developing new, and improving existing, agricultural crops and practices of value to Puerto Rico and the United States.

General Plan: Activities of the Puerto Rico Experiment Station are centered on problems created by or intensified by the war. The work of the Station is discussed more fully below under the following headings: (a) insecticidal crop investigations; (b) drug crop investigations; (c) food crop investigations; (d) plant introduction and propagation; (e) control of insect pests and diseases; (f) bamboo production and industrialization; and (g) cooperation with the Government of Puerto Rico and other agencies.

(a) Insecticidal crop investigations: Derris root, produced in the Far East, and Lonchocarpus root, produced in South America, have been the world's sources of supply of rotenone for insecticides which are toxic to many serious insect pests but harmless to man and domestic animals. The Far East supply of Derris root is now not available.

Due to the immediate need for increased sources of rotenone, the work on insecticidal plants is now largely directed to the rapid increase of high-yielding planting stock, developed at the Station, for establishment of plantings in Puerto Rico and Latin American countries. In order to stimulate production in the Western Hemisphere, the Station in cooperation with the Office of Economic Warfare and the Office of Foreign Agricultural Relations of the Department distributed approximately 1,500,000 cuttings to eleven countries in Latin America. The technical leader of this project was on loan to the Office of Economic Warfare for a period of approximately four months during the fiscal year 1943, selecting suitable planting areas in Central America.

Plants of a strain of Derris which produces a higher content of rotenone have been secured and are being tested further and propagated for commercial testing.

In addition to work connected with increasing the available supply of planting material of Derris, experiments were performed in an effort to determine better cultural practices for this crop. An experiment to determine the effects of mineral deficiencies on Derris showed that root yields were lowered by lack of potassium and potash. The withholding of magnesium definitely lowered rotenoid content, while the lack of sulphur decidedly increased it. Another experiment testing Derris showed that there is a direct correlation between high rainfall and root quantity

and quality. There was also an indication that elevation tended to reduce the rotenone content even though the yield of roots was comparatively high. In an age-of-harvest experiment, it was found that the yield of roots per acre increased steadily up to 27 months after planting, but total extractives and rotenone rose steadily up to 21 months and then declined slightly. This information is of importance at once in selecting planting sites and deciding on cultural practices for maximum rotenone production.

Further work on the development of a colorimetric test for the determination of rotenoids has progressed to the point where this method may now be considered to give consistently satisfactory results. This will be of great value in the selection of superior strains of rotenone-bearing plants, where a large number of samples is involved.

(b) Drug crop investigations: No other known drug can be used so effectively in the treatment of malaria as quinine. Practically all the quinine used in the United States formerly was obtained from the Dutch East Indies. As that source is now closed, quinine is recognized as a drug of strategic importance.

Because of the urgent need for a source of quinine, the work of the station on Cinchona, the tree from whose bark quinine is extracted, has been concentrated on the increase of planting stock and the solution of cultural problems. The Cinchona plant is recognized as one of the most difficult plants to grow. Production of nursery stock for field planting stock is a primary major problem. Investigations have now resulted in the production of thousands of seedlings which are thriving under highly satisfactory conditions. Methods of producing and carrying seedlings through the nursery stages for permanent planting for Puerto Rican conditions appear to be reasonably well solved. An area, in what is considered to be the best location in Puerto Rico for production of this crop, has been cleared as a permanent planting site. It is hoped to establish here some of the highest yielding strains of Cinchona as a permanent source of seed of such high-yielding strains and at the same time solve problems involved, and at present unsolved, in establishing permanent field plantings from nursery stock.

An experiment comparing the effect on Cinchona seedlings of various site conditions, showed that good soil drainage and adequate sunlight were necessary to promote optimum growth. Analyses of Cinchona bark samples indicated the importance of including alkaloid content along with vigor and yield of bark as one of the factors in selecting propagating stock. A study of bark samples showed no correlation between thickness of bark and alkaloid content.

Accumulated facts and new research findings were made currently available to other agencies concerned with quinine production.

(c) Food crop investigations: Under normal conditions, a large part of the food consumed in Puerto Rico is imported. Stimulation of the production of locally grown food products, normally important, assumed special importance under war conditions.

In conjunction with the Works Project Administration and the War Emergency Program of the Insular Government, the Station has continued cooperation through production of seed of valuable new food crops for distribution in a program for increased food production. Soybeans, not previously used for human consumption on the Island, have been found to be one of the highest yielding food crops per acre of land in Puerto Rico. The Seminole variety has grown well and produced abundantly. Increased seed production of USDA-34 variety sweet corn, developed by the Station, was undertaken. About 8,000 pounds of seed of these two varieties was distributed to growers. Also, 16,531 pounds of selected yams were grown and distributed for planting material in the food production program. In addition, small quantities of the above seeds were sent upon request to many Latin American countries for testing as to their possible value in increasing food production throughout the tropics.

(d) Plant introduction and propagation: During the year, work in this field has been concentrated largely on furnishing planting materials needed by the armed forces in Puerto Rico. The Station has cooperated in landscaping and camouflage at Army and Navy bases, by designing planting plans, by advising as to which varieties are best adapted to particular purposes, by furnishing planting materials and by supplying information as to planting methods, care of plants, and control of insect pests. During the fiscal year a total of 189,133 plants were distributed on the Island to Federal and Insular agencies and to private individuals. In addition, large quantities of seed and grass sod and runners were distributed.

The Station during the year has undertaken a number of special experiments, some of which were requested by other agencies, to locate and develop agricultural materials of possible strategic importance, such as:

1. An experiment was conducted with Urena lobata, a possible substitute for jute, which indicated that this plant would make good growth throughout the year in the latitude of Puerto Rico.
2. At the request of the Office of Economic Warfare, a survey of sisal plantations and sisal production machinery in Puerto Rico was conducted by the Station.
3. Abaca, Manila hemp, was originally introduced into Puerto Rico from the Philippines by the Station in 1911. Because of the present shortage of fiber crops, planting materials of abaca have been made available to growers in Mexico and elsewhere during the year.

4. Planting materials of Castilla elastica and Cryptostegia grandiflora as well as other plants of possible value in the production of rubber were collected from Cuba and elsewhere for experimental tests.

5. Yam beans, a potential source of rotenone, were collected from Mexico, Guatemala, China, and other locations for testing as to yield and insecticidal properties.

6. Also, eight varieties of the family to which the quinine-producing plants belong were propagated as a possible source of anti-malarials.

7. Since it was known that waste in the distillation of bay leaves contained small amounts of tannins, analyses of this material were made which indicated that tannins suitable for tanning purposes were obtainable from this source.

(e) Control of insect pests and diseases: The work of the Puerto Rico station involving the introduction, testing, and improvement of many different plants of economic and sometimes strategic importance, requires investigations to control insect pests and diseases of these plants.

Because of the importance of corn in tropical agriculture, investigations were carried out as to the best treatment of seed corn to control insects attacking the seed, particularly the rice weevil. This insect makes untreated seed corn almost completely valueless within a matter of a few weeks. After considerable experimentation, it was learned that a method of treating seed corn by dusting with lime proved to be very effective in the control of this insect. The most effective treatment was rolling the seed ears in lime as soon as the grains dried enough to separate.

In investigations concerning the powder post beetle, which renders native bamboos worthless for construction purposes, tests showed that Bambusa textilis, B. longispiculata and Dendrocalamus membranaceus, which are imported varieties, can be considered highly resistant to this destructive pest, as well as Bambusa tulda, which has previously been reported. It was apparent from the experiments run that the starch content of the dry wood was an important factor in determining susceptibility to this insect.

Since the introduction and liberation of beneficial insects which prey on insect pests have produced fine results, cooperation with the Bureau of Entomology and Plant Quarantine in the introduction of insect parasites and predators was continued. Shipments of sugarcane borer parasites were received from Brazil, and cotton stainer parasites from Peru. Requests were received for a number of species already established in Puerto Rico and shipments of four species of predators were made to Trinidad and the Canal Zone. Shipments of white-grub predators were sent to Florida. One shipment contained the giant toad, which is an important predator of May-beetles, adults of the white grubs, and other insects in Puerto Rico; and other shipments contained a luminous click-beetle, the larvae of which prey on the grubs themselves.

(f) Bamboo production and industrialization: Formerly most of the common lumber used for construction purposes in Puerto Rico has been shipped in from the southern United States. Shipping limitations, plus the need for this lumber for direct war purposes, has greatly reduced the supply available for use in the Island. Since bamboo flourishes in many parts of Puerto Rico, the Station has concentrated on importation of varieties of bamboo suitable for construction purposes and has conducted investigations as to the use which could be made of these varieties. The principal species distributed for increase throughout the Island has been the imported industrial species Bambusa tulda. Several other varieties, however, have also been tested and should prove useful for construction purposes inasmuch as they have shown marked resistance to infestation by the powder post beetle, which renders local bamboo useless for construction purposes.

During the year a study was started on the use of bamboo as a reinforcing material for concrete construction and preliminary results have indicated that bamboo might thus be used at least in small simple structures. If practicable, this would result in a marked saving of strategic materials and would provide a cheap and ready source of building material for the tropics. This study was conducted in cooperation with the University of Puerto Rico, School of Agriculture.

Considerable impetus has been given the bamboo program since the first commercial manufacture of bamboo furniture on the Island was realized during the year. The Coordinator of Inter-American Affairs cooperated in the program and their designer developed several new and interesting designs particularly adapted to bamboo. The use of patterns and templates has facilitated rapid and uniform fabrications.

The total distribution of bamboo plants for testing purposes and for increasing supplies of commercially usable varieties was 3,790 during the year. This amount is larger than the combined distribution for all previous years.

(g) Cooperation with the Government of Puerto Rico and other agencies: For a number of years the Government of Puerto Rico has annually appropriated funds for expenditure at the Federal Experiment Station to make possible active cooperation in the conduct of research felt to be of direct importance to the agriculture of the Island. This research has been directed principally during the year to work on essential oils, spices, and vanilla.

An experiment on citronella grass showed that drying and haying of the grass prior to distillation resulted in a considerable loss of oil. This is in contrast to some other essential oil-bearing plants which produce higher yields when dried prior to distillation.

An experiment on the production of Chinese ginger gave yields of ginger as high as 37,000 pounds per acre. This variety has been recently introduced into Puerto Rico and there is every indication that this could be a profitable crop for the Island. Available planting material is being reproduced as rapidly as possible.

Further investigations were conducted in an effort to determine proper cultural practices to be followed in the growing and production of vanilla. One of the greatest difficulties in the production of vanilla in Puerto Rico has been a root rot disease which has made it difficult to keep plants alive and healthy. The results obtained thus far in soil alteration experiments for the control of this disease indicate that the addition of soft limestone to mulch provides better aeration and drainage which results in superior vegetative growth, higher survival of the plants, and heavier flowering the first producing year.

Observations on various support trees for vanilla have indicated that the cashew nut tree provides, without additional shade protection, a quantity and quality of light which is highly favorable to growth. This tree keeps its leaves throughout the year. It can be highly recommended as a support for vanilla vines.

Splitting of vanilla beans reduces their commercial value. In an experiment to determine methods of reducing the amount of splitting, it was discovered that the least splitting occurred in beans that were killed by scratching with a pin, by placing in an oven, or by dipping in hot water and then cured to contain about 35 percent moisture.

(d) Special Research Fund, Department of Agriculture
(Allotment to Office of Experiment Stations)

This budget schedule covers obligations under an allotment for administration of payments to States for research under Title I of the Bankhead-Jones Act of June 29, 1935. By decision of the Comptroller General, the amount of this allotment is limited to 2% of the Special Research Fund. The details of administration of payments to States are explained more fully under the preceding subappropriation item "(b) Administration of Grants and Coordination of Research with States."

(e) Emergency Relief, Agriculture, Planning and Review of W.P.A. Projects
(Allotment to Office of Experiment Stations)

This budget schedule covers past obligations under an allotment for planning and administrative review of W.P.A. projects which were conducted or contemplated at the State agricultural experiment stations.

(f) Working Funds (Office of Experiment Stations)

This budget schedule covers obligations under advances pursuant to Section 601 of the Economy Act of June 30, 1932, for services performed for the Foreign Economic Administration in connection with the program to increase rotenone production, the amounts for which are included in the following statement of supplemental funds.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS

Item	: :Obliga- :tions, : 1943	:Estimated: : obliga- : : tions, : : 1944	:Estimated: : obliga- : : tions, : : 1945
<u>Special Research Fund, Department of</u>	:	:	:
<u>Agriculture:</u>	:	:	:
For administration of payments to States:	:	:	:
for research under Act of June 29,	:	:	:
1935	:\$22,978:	\$22,941:	\$22,941
<u>Emergency Relief, Agriculture, Planning and</u>	:	:	:
<u>Review of W.P.A. Projects:</u>	:	:	:
Planning and review of projects	407:	--:	--
<u>Working Funds, Office of Experiment</u>	:	:	:
<u>Stations (Advances from Foreign Economic</u>	:	:	:
<u>Administration):</u>	:	:	:
Harvesting, packing and shipping	:	:	:
Derris cuttings	823:	13,500:	--
Survey of Derris producing areas	2,020:	--:	--
Total, working funds	2,843:	13,500:	--
Total Obligations under Supplemental Funds ..	26,228:	36,441:	22,941

PASSENGER-CARRYING VEHICLES

The Office of Experiment Stations does not contemplate any expenditures during the fiscal year 1945 for the purchase of passenger-carrying vehicles. It is expected that the three vehicles now being operated will continue in operation during the fiscal year 1945. These three vehicles have travelled 58,196, 42,373, and 25,169 miles at the present time and will continue to be used by the staff of the Federal Experiment Station at Mayaguez, Puerto Rico, where these cars are located.

CONFIDENTIAL - SECURITY INFORMATION

1. The purpose of this document is to provide information regarding the security of the system. It is intended for use by personnel who are responsible for the operation and maintenance of the system.

2. The information contained herein is classified as CONFIDENTIAL - SECURITY INFORMATION.

3. The information contained herein is classified as CONFIDENTIAL - SECURITY INFORMATION. It is intended for use by personnel who are responsible for the operation and maintenance of the system. The information is provided for your information and is not to be distributed outside the system.

4. The information contained herein is classified as CONFIDENTIAL - SECURITY INFORMATION.

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AGRICULTURAL RESEARCH ADMINISTRATION

Bureau of Animal Industry

(a) General Administrative Expenses

Appropriation Act, 1944	\$165,575
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+29,804
Total anticipated available, 1944	195,379
Budget estimate, 1945	<u>195,379</u>

PROJECT STATEMENT

Project	: 1943	: 1944 :(estimated):	: 1945 :(estimated):	: Increase or decrease
1. General administration and business service:	:	:	:	:
Bureau of Animal Indus-	:	:	:	:
try.	\$138,307:	\$148,179	\$148,179	- -
Transfer to Food Distri-	:	:	:	:
bution Administration:	43,500:	47,200	47,200	- -
Total obligations	181,807:	195,379	195,379	- -
Covered into Treasury in accordance with Public	:	:	:	:
Law 674	110:	- -	- -	- -
Unobligated balance . . .	23:	- -	- -	- -
Total available	181,940:	195,379	195,379	- -
Transferred to other appro-	:	:	:	:
priations (as shown in	:	:	:	:
Budget schedules) . . .	+6,160:	- -	- -	:
Transferred from "Salaries	:	:	:	:
and expenses, animal in-	:	:	:	:
dustry, Agricultural Re-	:	:	:	:
search Administration"	:	:	:	:
eradicating tuberculosis	:	:	:	:
and Bang's disease. . .	-8,800:	- -	- -	:
Anticipated deficiency for	:	:	:	:
overtime pay.	- -:	-29,804	- -	:
Total estimate or	:	:	:	:
appropriation	179,300:	165,575	195,379	:

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	*\$6,898	- -	- -
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	7,300	\$29,804	\$29,804
Total cost of overtime (7 months in 1943)	14,198	29,804	29,804

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

This appropriation provides finances for general administration of programs of work which are concerned primarily with the protection and development of the livestock industry and animal food resources of the United States.

The Bureau of Animal Industry conducts scientific investigations of the causes, prevention, and treatment of livestock diseases, some of which are transmissible to man; investigates the prevalence of livestock diseases and aids in their control or eradication, often directing extensive field activities; carries on investigations and experiments in the breeding, feeding and management of livestock; and administers the animal quarantine acts, the diseased-animal transportation acts, and the Virus-Serum-Toxin Act. For facility and economy of operation, administrative functions common to the entire Bureau, which is composed of 7 operating divisions, are grouped directly in the office of the Chief. These include primarily the determination of general policies and the supervision of all activities of the Bureau.

The Food Distribution Administration administers the Federal Meat Inspection Acts and the 28-Hour Law, under funds transferred from the appropriation "Salaries and expenses, Bureau of Animal Industry" (including transfer from "general administrative expenses" as indicated on the foregoing project statement), pursuant to Executive Order 9280 of December 5, 1942.

The obligations against these transferred funds are shown on a consolidated basis, in the Food Distribution Administration Section of the Budget (page 453 of the Subcommittee Print). The amounts of the transfers are as follows:

Transfers from	1943	Estimated, 1944	Estimated, 1945
General administrative expenses	a/ \$43,500	a/ \$47,200	\$47,200
Inspection and quarantine (28-hour law)	b/ 28,295	b/ 29,664	29,664
Meat inspection	c/ 7,689,559	c/ 8,585,236	9,327,294
Totals	d/ 7,761,354	d/ 8,662,100	9,404,158

- a/ Includes \$3,500 appropriated for war overtime pay.
b/ Includes \$2,500 appropriated for war overtime pay.
c/ Includes \$894,000 appropriated for war overtime pay.
d/ Includes total of \$900,000 appropriated for war overtime pay.

(b) Animal Husbandry

Appropriation Act, 1944	\$800,000
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	99,500
Total anticipated available, 1944	899,500
Budget estimate, 1945	899,500

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Swine husbandry investigations	143,938	150,589	150,589	- -
2. Sheep and goat husbandry investigations	149,219	159,179	159,179	- -
3. Horse and mule husbandry investigations	39,964	44,005	44,005	- -
4. Beef cattle husbandry investigations	172,567	199,984	199,984	- -
5. Dual-purpose cattle husbandry investigations	63,378	68,110	68,110	- -
6. Poultry husbandry investigations	240,039	270,327	270,327	- -
7. Certification of pedigrees of imported registered livestock	6,406	7,306	7,306	- -
Covered into Treasury in accordance with Public Law No. 674	1,798	- -	- -	- -
Unobligated balance	5,361	- -	- -	- -
Total available	822,670	899,500	899,500	- -

PROJECT STATEMENT (CONTINUED)

Project	1943	1944 :(estimated):	1945 :(estimated):
Transferred to other ap- propriations (as shown in Budget schedules)....	+9,330	- -	- -
Transferred from "Sal- aries and expenses, animal industry, Agri- cultural Research Ad- ministration", eradi- cating tuberculosis and Bang's disease.....	-21,000	- -	- -
Anticipated deficiency for overtime pay.....	- -	-99,500	- -
Total estimate or appropriation.....	811,000	800,000	899,500

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Animal husbandry: For investigations and experiments in animal husbandry [; for experiments in] and animal and poultry feeding and breeding, including cooperation with the State Agricultural experiment stations and other agencies, including repairs and additions to and erection of buildings necessary to carry on experiments, [\$800,000: Provided, That of the sum thus appropriated \$240,935 may be used for experiments in poultry feeding and breeding, of which amount \$44,080 may be used in cooperation with State authorities in the administration of regulations for the improvement of poultry, poultry products and hatcheries] \$899,500.

The first change in language deletes the words "for experiments in" and inserts "and" for the purpose of simplifying and shortening the wording of the item.

The addition of the words "and poultry" and the elimination of the specific proviso relating to the amount which may be used for poultry feeding and breeding, of which amount a certain sum may be used in cooperation with State authorities in the administration of regulations for the improvement of poultry, poultry products, and hatcheries, are recommended in the interest of simplicity. Expenditure records under this appropriation are maintained on a project basis, including a project on poultry husbandry investigations, and are shown in the budget each year.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed.....	\$44,405	\$400	\$400
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944, and included in budget estimate, 1945).	- -	99,500	99,500
Total cost of overtime (7 months in 1943).....	44,405	99,900	99,900

WORK UNDER THIS APPROPRIATION .

Objective: Through research, to develop means of improving the productivity, both in quantity and quality, of our domestic farm animals and poultry. In addition to research, the work in connection with the administration of the provisions of paragraph 1606 of the Tariff Act of 1930 in regard to the certification of purebred animals imported by citizens of the United States for breeding purposes is carried on under this appropriation.

The Problem and its Significance: Livestock and poultry products vary greatly in quantity and quality per animal unit. Many losses occur which could be avoided by improved breeding, feeding, and management practices. Although the average productivity of the Nation's herds and flocks has increased many fold in the past half century, strains of animals and methods of feeding which outdo the present average in some cases by one and two hundred percent have been developed. The development of these strains of livestock and of these new principles of feeding repays many times over the research appropriations expended, but such research cannot be done by individual farmers and poultrymen as it is too time-consuming, too costly, and requires far too much pooling of trained talent.

General plan: (a) To test the merits of different systems of breeding; (b) to develop strains possessing inherent characters for high level of performance; (c) to study the various management factors that tend to keep livestock healthy and reduce losses; (d) to determine the fundamental nutritive requirements of livestock; (e) to determine the best methods of using feeds to obtain maximum results in growth and reproduction; and (f) to study the effects of the foregoing and of processing upon the quality of meat, eggs, animal fibers, and other productiveness of livestock.

Receipts: During the fiscal year 1943, approximately \$90,000 from the sale of livestock and livestock products which had served their purpose for investigational work was returned to the miscellaneous receipts fund of the Treasury.

Examples of Progress and Current Program: The investigations conducted under this appropriation have been redirected in every way possible to be of maximum assistance in the war effort. It has been possible in many instances to apply the results of research to further the war effort on the food front. Examples of recent accomplishments are given below.

Swine investigations: In order to determine feed requirements for successive increments of gain, an experiment was conducted in which hogs were fed individually in concrete pens from weaning to final weight. These hogs were fed to weight intervals of 175, 225, 275, 325, and 375 pounds. More feed was required for each succeeding unit of gain as the hog increased in weight. Approximately 206 pounds of feed were required to increase the weight from 175 pounds to 225 pounds, 223 pounds to bring the weight to 275 pounds, 252 pounds to bring weight to 325 pounds, and 276 pounds to increase weight to 375. These data indicate that with a heavy demand for land intermediate type hogs may be fed profitably to weights up to 275 pounds liveweight if feed supplies are available. If the need for hog fat is limited, then it is more desirable to market lighter weight hogs of 200 to 225 pounds liveweight.

It has been found that a considerable saving of concentrate feeds can be effected and the health of swine protected more effectively by including legume hays in the wintertime ration. Recent experiments in which ground alfalfa, soybean, and lespedeza hays were used at levels of 0, 5, 10, 15, and 20 percent of the ration have shown that more rapid gains were secured in fattening pigs on the 5 and 10 percent levels than on the other levels. Up to the 10 percent level the ground hays effected an appreciable saving of concentrates. However, even at the 15 and 20 percent levels the rate of gain was good and the total feed required per unit of gain was not too high to make such practice profitable in areas where protein supplements are high in price or difficult to obtain because of transportation problems.

In pork studies, emphasis has been placed very largely on certain lines of study already in the program and on new problems closely related to the war emergency. These investigations had to do with various methods of preservation, including dehydration, freezing and freezer storage, and curing. Studies have been conducted to develop practical methods for producing space- and weight-saving dehydrated pork that is wholesome palatable, highly nutritious, and of good keeping quality without refrigeration. Studies of processing factors included fatness of raw material; particle size; temperature and method of pretreatment; temperature, humidity, air velocity, and air direction in drying; vacuum drying; and others. Factors such as moisture, fat content, bacterial flora, palatability, keeping quality, nutritive value, compressibility, packaging requirements, and rehydration capacity were included in research on the product.

In further work on coating frozen pork by dipping in melted lard, the protected samples were slightly superior to the unprotected samples in desirability of flavor when stored at the same temperatures. A more distinct difference in this characteristic was observed when the meats were stored at different freezing temperatures, the results favoring the lower. Due to chipping off, coatings of half lard and half beef tallow and all tallow were unsatisfactory. An ice glaze evaporated and such protection to be effective would require renewal every 2 to 4 weeks, depending upon the temperature and relative humidity of the storage room. As a wartime substitute for moisture-vapor-proof wrappings customarily used for meat in freezer storage, lard appears quite promising.

Sheep, goat, and animal fiber investigations: The development of superior strains of sheep from hybrid foundations has made exceptional progress during the past two years and the resulting animals are now at a stage of excellence which makes them valuable in sheep breeding operations on the range and the farms. At Dubois, Idaho, two new breeds known as the Columbia and the Targhee have been developed. The Columbia ewes are constantly improving in type, length of staple, and other qualities of the wool, and are in exceptional demand by the breeders in the region. The Targhee breed developed at this same station from crosses between Rambouillet and Corriedale now shows about 10 percent greater purity of breeding than a few years ago and is finding widespread use in the area. At Middlebury, Vermont, a new breed known as the Southdale, developed from foundation of selected Southdown and Corriedale crossbreeds, shows an excellent combination of the mutton qualities of the Southdown and the superior wool qualities of the Corriedale. Their compact bodies and excellent fleeces are attracting much attention from the sheep raisers of the New England region for use in farm flocks.

Studies at Beltsville, Maryland, on the practical feeding properties of feeds for sheep and lambs for the production of maximum quantities of high quality wool and lamb meat included the testing of two new feeds in cooperation with the Bureau of Agricultural and Industrial Chemistry. These feeds were artificially dried pea vines and artificially dried lima bean vines. The sheep fed pea vines gained weight and stored nitrogen in their body tissues while those fed lima bean vines failed to gain weight and stored less nitrogen. It appears from the studies that pea vines and empty pods are satisfactory forage for sheep and that they are superior to lima bean vines and empty pods, when fed exclusively, a fact that has special significance in time of war, when sheep feeds are scarce.

In an effort to distribute the milk supply of goats throughout the year one-third of the female milk goats at Beltsville that were artificially stimulated to breed out of their usual breeding season were successfully caused to freshen ahead of the regular kidding season. In support of this work sexual activity of male goats was followed through the year. Semen studies indicated that bucks in good general condition are suitable for breeding at all times of the year, although less sexual

activity was shown during May and June, at the time when does are normally not breeding. The production of extra-seasonal breeding in goats is very important to the milk-goat industry throughout the year.

In view of the great demand for wool and other animal fibers under war conditions the use of certain fiber materials heretofore neglected now becomes a necessity. One of the most important of these animal fibers is feather fiber. This is a product which has recently been developed at Beltsville, Maryland. It consists of feathers from which the quills have been removed. This material has excellent insulating and heat-retaining properties and is suitable for use in sleeping bags as a substitute for down and waterfowl feathers that are so scarce because of the war. An air separation method for removing the softest and choicest of ordinary chicken feathers has been developed. This product is known as fractionated chicken feathers and will fill the requirements for sleeping bags when a superior quality of chicken feathers is needed. Results obtained on the preservation of feathers will make it possible to ship raw feathers to processing plants, thereby salvaging many millions of pounds of feathers ordinarily wasted.

Horse and mule investigations: Significant progress has been made in the development of record-of-performance tests for use in measuring working ability in horses as a basis upon which to make selections of breeding stock. In order to make further progress in the development of superior breeding strains it has been necessary to conduct fundamental research on the nature of the things needing improvement. In cooperation with the Missouri Agricultural Experiment Station, new apparatus has been designed and constructed which permits measuring the oxygen consumption rate during rest and work. It has been found that oxygen consumption is directly proportional to body weight in nearly mature work animals of different sizes. It was also observed that the energy requirement of the horse standing up does not differ from that of the animal lying down. Cattle and some other animals expend about 9 percent more energy when in the standing position. These investigations as well as others conducted at the U. S. Morgan Horse Farm at Middlebury, Vermont, furnish a means of measuring the efficiency of energy output in relation to feed consumed. The ability to work over long periods of time on a given amount of feed is a characteristic in which individual horses differ but heretofore there has not been any method by which such differences could be determined and the selection of breeding stock made in a definite manner.

The usual practice on farms is to utilize a maximum of cheaply grown roughages in feeding the work horses. In direct contrast to this is the wartime demand, due to limitations on transportation, for a minimum of bulk and weight in the ration of both pack and cavalry horses. To a lesser degree the problem is of importance in the case of city work horses, especially in cities located in feed importing areas. With the aid of an emergency grant of funds from the Office of Scientific Research and Development, studies already completed have shown that

horses can be kept in excellent condition on a ration supplying as little as 2 pounds of hay in contrast to the usual practice of allowing 10 pounds or more per 1000 pounds of live weight. The reduction in hay is compensated for by supplying additional concentrate feed which furnishes the needed energy, protein, vitamin, and mineral constituents lost with the decrease in hay content of the ration. Such a ration actually represents a decrease in weight of 30 percent of that of the control ration and in bulk or volume a still greater decrease. The decrease in weight results partly from the increased utilization of protein, carbohydrate, and other nutritive constituents in the ration, which includes a lowered percentage of crude fiber.

Beef and dual-purpose cattle investigations: The shortage of beef in this country, due largely to increased supplies required for the armed forces, can be overcome to some extent by the immediate application of the results of many of our investigations relating to feeding, breeding, and management of beef cattle. During the present emergency many of our feeding and management investigations have been modified so as to give information on new problems which have possibilities of being solved in relatively short periods of time.

Three years experiments in southern Texas to study the effects of supplying phosphorus supplements to cattle grazing on range deficient in this mineral show that phosphorus deficiencies in range cattle may be prevented and corrected, if not too far advanced, by hand-dosing the cows with either bonemeal or disodium phosphate in such amounts as will supply 6.5 grams of phosphorus per head 6 days per week.

In areas where cottonseed meal and hulls are depended upon almost solely for the fattening of cattle for beef, losses of considerable magnitude, as represented by low gains and in some instances deaths, have resulted from vitamin A deficiencies. Our recent investigations have proved that vitamin A deficiencies in cattle-fattening rations can be controlled when from 2000 to 2500 milligrams of carotene are supplied with each 100 pounds live weight of cattle. Dehydrated alfalfa leaf meal has been proved to be a more effective source of carotene than silages made from sorghos or sorghums, when these feeds were fed so as to supply the same quantity of carotene. As little as one-half pound of choice quality dehydrated alfalfa leaf meal may, in otherwise vitamin A deficient rations for yearling cattle, meet the carotene requirements. The results of these studies are of particular importance to livestock raisers in the South and Southwest regions of the United States, where available feeds are extremely low in carotene. Further studies are necessary to determine the relative values of other feeds and fish oils as sources of carotene.

In experiments already completed there are indications that sweet potato meal (dehydrated sweet potatoes) and sweet potato pulp (by-product of starch manufacturing) can be used satisfactorily as carbohydrate feeds to partially replace corn in cattle-fattening rations. A single-grain test showed that sweet potato meal was equally as

efficient as cracked shelled corn. Sweet potato pulp, when fed with corn in the proportion of 1 pound by weight of pulp to 3 of corn, was 10 percent more efficient than when fed in equal parts of each by weight. The use of sweet potato products in cattle rations makes it possible to fatten greater numbers of steers in the Southeastern States and thus increase the tonnage of finished beef in that area.

Investigations in the southern Great Plains show that pastures mowed to control the growth of sagebrush greatly surpass the unmowed pastures in density and production of the better species of vegetation. The mowed pastures have supported more cattle on fewer acres than those not mowed and developed forage production in excess of cattle needs. They have also produced significantly greater steer gains per head and more than twice as much beef per acre in the same length of time.

In the coastal region of the Southeast there are vast areas of forest land, which are not being fully utilized. The most important problem appears to be a shortage of feed with which to winter the breeding herds. The past year's study indicated that severe losses in weight of cattle in the region during the winter can be avoided by feeding as little as 2 pounds of a protein concentrate per head daily, as a supplement to the range vegetation. There are indications that the feeding of cottonseed meal stimulated the cow's appetite, resulting in a greater use of the native range. These experiments in the coastal region of the Southeast should be instrumental in increasing the potential beef supply in an area which has not been too productive in this respect.

While beef and dual-purpose cattle breeding programs are naturally of long duration, our research projects in this field are already yielding data which can be given immediate application to privately owned herds. Methods of measuring performance of beef and dual-purpose cattle have been developed whereby the breeding ability of breeding stock can be determined through feeding tests with the offspring. Statistically significant differences between lines have been observed with respect to birth and weaning weights of calves, efficiency and rate of gain with steers, and weights of heifers at 18 and 30 months of age. The use of proved bulls has increased beef and milk production in the herds. In one of our genetic herds of Herefords a certain line has been outstanding. The original sire used in this line has shown considerable superiority as measured by rate and efficiency of gain and quality of product. His sons have made still further contributions to the herd in these respects. In the past year's record-of-performance studies, the steers by one of these sons made 2.28 pounds daily gain per head for 273 days which was 25 percent more than for the average of all other Hereford groups. The steers by this bull also scored the highest in quality, showed the least variability, and weighed 158 pounds more per head at the end of the fattening experiment. Similar progeny tests with beef and Milking Shorthorns are definitely showing genetic differences in the breeding ability of sires, as measured not only by gains, efficiency, and quality of product, but by ratio of muscle to bone in the carcass.

Investigations have been conducted, and in certain major phases are continuing, to develop practical methods for producing space- and weight-saving dehydrated beef possessing wholesomeness, palatability, high nutritional value, and good keeping quality without refrigeration. Processing factors studied have included fatness of raw material; particle size; temperature and method of pretreatment; temperature, humidity, air velocity, and air direction in drying; vacuum drying; and others. Moisture and fat content, bacterial flora, flavor, vitamin content, biological value of the protein, and compressibility were among the quality factors included in research on the product.

Poultry investigations: Maintenance of the current high rate of production of poultry and poultry products needed in the war food program must depend on more efficient use of available supplies of feed, labor, and equipment. Development and use of better breeding stock will greatly increase production efficiency. Such stock can be developed and identified through carefully controlled breeding research.

Research on poultry breeding at the Beltsville Research Center indicates that egg production may be maintained at much higher levels than the current average through family selection of breeding stock. Use of sires from family selected stock developed by private breeders in the hatchery supply flocks of the country can produce at least a 10-egg increase in the average annual production. Use of such sires has been greatly increased through a Victory Cockerel Campaign.

Reduction of broodiness and other undesirable inherited factors in standardbred strains of Single-Comb Rhode Island Reds have been accomplished through inbreeding at the Beltsville Research Center. The crossing of resulting inbred strains of Single-Comb Rhode Island Reds with standardbred non-broody Single-Comb White Leghorns indicates that inbreeding followed by crossbreeding may become a valuable method for increasing egg production. Further research to develop superior inbred strains and to test the progeny of crosses of these strains is necessary.

Research on breeding chickens for superior egg quality with respect to physical condition of egg white, strength and soundness of shell, and freedom from blood spots on the yolk through family selection has demonstrated the effectiveness of this technique for this purpose. About 5 percent of all eggs produced are lost through breakage or defects. Research is continuing to determine the manner of inheritance of genetic traits affecting egg quality and for developing strains of poultry that will produce eggs of uniformly superior quality.

Comparisons have been made of the yields of meat from four different varieties of turkeys--Broad Breasted Bronze, standardbred Bronze, White Holland, and Beltsville Small White. Broad Breasted Bronze and Beltsville Small White turkeys were found to have 20 percent and 5 percent, respectively, more breast meat than the standardbred Bronze and White Holland turkeys. Broad Breasted Bronze and standardbred Bronze were found to have 10 percent and 5 percent, respectively, more leg meat than the other two varieties. It also was found that

there are differences among the varieties and strains in the age at which they attain a desirable finish. Such differences are for consideration when poultry raisers are deciding at what age their turkeys should be marketed.

Research on egg quality and egg preservation is of great importance during the war because the quality of shell eggs used in the manufacture of dried eggs greatly affects the quality of the product and because shortages of transportation facilities necessitate some shipping and holding of shell eggs without refrigeration. The use of controlled temperatures in processing eggs to obtain partial pasteurization and thermo-stabilization has been investigated, and suitable ranges of temperature and length of treatment ascertained. Thermo-stabilization permits storage of eggs for several weeks without refrigeration and may prove of great importance in maintaining quality of eggs supplied to our armed forces.

The method of thermo-stabilization may be applied to eggs older than one day from the time of laying. It thus supplements the method of oil dipping eggs on the day laid which was previously shown to give excellent preservation under non-refrigerated conditions for at least a month. Early oiling is simpler and is equally as efficient as thermo-stabilization, but its use is now limited to infertile eggs processed when less than a day old. Much further research is necessary before the current loss of about 5 percent of all eggs laid can be eliminated.

Many special feed mixtures have been formulated and tested during the past year. As a result of this work, there have been issued two publications--one processed, one printed--on wartime feed mixtures for poultry. Many of the formulas given in these publications make the maximum use of soybean meal.

Feeding tests indicate that yellow milo and hegari are equal to corn in an otherwise well-balanced diet for laying hens. Other tests made within the last few years indicate that almost any grain--oats, barley, wheat, corn, or grain sorghum--may be used as the chief ingredient of mixed feeds for poultry, so long as the other ingredients are selected so as to give a balanced diet.

It has been ascertained that almost any vegetable oil, except cottonseed oil, may be used as a carrier for vitamin D and the other fat soluble vitamins in feeding poultry without affecting the hatchability of the eggs or the time of occurrence of embryonic mortality.

One of the impending shortages among feedstuffs are the common sources of vitamin A. Among possible new sources of this important vitamin are the acorns of the willow oak, *Quercus phellos*. One sample was found to have a vitamin A potency of approximately 80,000 International units per pound. Thus, 2 to 5 percent of ground acorns of the willow oak is sufficient to supply all the vitamin A required by a growing chick.

The efficiency of farm poultry production can be greatly increased through the adoption of sound methods of breeding and pullorum disease control. Through these measures and through better care, feeding, and management, average egg production per hen in the United States increased from 89 eggs in 1934 to 113 eggs in 1942. The National Poultry Improvement Plan program, initiated in 1935 and widely adopted as the standard program for organized breeding and pullorum disease control by poultrymen, has contributed greatly to this increase. From 1936, and first year of operation of the plan, through the past four years, participation has increased as follows:

Extent of participation during year ended June 30				
Item	: 1936	: 1940	: 1942	: 1943
	: (Number)	: (Number)	: (Number)	: (Number)
States.....	34:	44:	44:	44
Hatcheries.....	1,017:	2,192:	2,667:	2,712
Egg capacity of hatcheries.....	38,066,000:	90,578,718:	135,742,179:	147,079,132
Breeding flocks.....	23,813:	50,559:	69,681:	69,569
Breeding birds.....	3,522,409:	10,714,238:	15,518,967:	16,534,458
Breeding birds tested for:				
pullorum disease.....	2,053,159:	8,990,869:	14,906,649:	15,900,011
U.S.R.O.P. 1/ flock				
owners.....	2/	335:	317:	326
U.S.R.O.P. flocks.....	190:	429:	425:	435
Birds entered in trap-				
nest flocks.....	66,547:	144,447:	160,022:	151,685
U.S.R.O.P. breeding pens	2/	2,429:	2,999:	3,261
Females in U.S.R.O.P.				
pens.....	2/	32,949:	42,841:	45,964
1/ U. S. Record of Performance	2/ Complete information not available			

A study of the production records of 59,600 pullets trap-nested on U.S. Record of Performance farms during the 1940-41 trap-nest record year shows that the hen-housed average production was 171 eggs. U.S.R.O.P. breeding cockerels are produced in the advanced breeding stage of the plan and are used to mate to carefully selected females in hatching egg supply flocks to improve the quality of chicks through breeding.

Certification of pedigrees of imported registered livestock: During the fiscal year 1943, a total of 22,430 purebred breeding animals were certified in this project. This is an increase of 2,183 animals as compared with the importations for the previous fiscal year, the principal gains being in the importation of cattle, notably Holstein-Friesians and Ayrshires. Of the breeding animals certified this year 22,209 came from Canada. The animals certified included 64 horses, 18,280 cattle, 3,451 sheep, 8 goats, 256 swine, 370 dogs, and 1 cat.

(c) Diseases of Animals

Appropriation Act, 1944.....	\$706,463
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943.....	50,476
Total anticipated available, 1944.....	756,939
Budget estimate, 1945.....	<u>756,939</u>

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Investigations of brucellosis (contagious abortion) of livestock	\$218,753	\$267,069	\$267,069	- -
2. Investigations of infectious diseases of livestock and poultry caused by bacteria and fungi, other than brucellosis	96,781	109,158	109,158	- -
3. Investigations of infectious diseases of livestock and poultry caused by viruses	88,015	97,995	97,995	- -
4. Investigations of noninfectious diseases of livestock and poultry	43,731	48,041	48,041	- -
5. Investigations of protozoan parasites of livestock and poultry, including coccidiosis	68,186	71,079	71,079	- -
6. Investigations of worm parasites of livestock and poultry, such as tapeworms, flukes, and roundworms ...	65,733	72,007	72,007	- -
7. Investigations of miscellaneous parasites of livestock and poultry	44,362	42,687	42,687	- -
8. Investigations of treatments for parasites of livestock and poultry	48,424	48,903	48,903	- -
Covered into Treasury in accordance with Public Law No. 674	1,192	- -	- -	- -

PROJECT STATEMENT (Continued)

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
Unobligated balance	32,553	-	-	-
Total available	707,730	756,939	756,939	-
Transferred to other appropriations (see Budget Schedules for details)	+7,270	-	-	-
Anticipated deficiency for overtime pay	-	-50,476	-	-
Total estimate or appropriation	715,000	706,463	756,939	-

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$37,837	\$24,300	\$24,300
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	-	50,476	50,476
Total cost of overtime (7 months in 1943)	37,837	74,776	74,776

WORK UNDER THIS APPROPRIATION

Objective: To obtain information leading to measures for the control of the infectious and non-infectious diseases of domestic animals, including poultry, which are of particular importance at the present time; and to develop practical methods of coping with the numerous parasites that produce stunting, unthriftiness, and deaths in livestock and poultry.

The Problem and its Significance: The country's livestock and poultry are subjected to attack by many infective agents classified into three general groups, bacteria, fungi, and filtrable viruses. Losses are also caused by mismanagement and injurious agents such as specific poisons and certain plants. Infection is acquired through direct or indirect contact of healthy with diseased animals or their discharges, through inhalation of contaminated air, ingestion of contaminated feed and water, insect and similar vectors, and accidental or surgical wounds. In certain diseases the infection spreads rapidly so that the whole herd becomes affected within a few days; other infections spread slowly and insidiously. Some diseases lend themselves to control to a greater or less degree by vaccination procedures, while other affections do not readily yield to such measures, and specific treatment, prevention, or eradication are indicated. In brief, the problem of disease control involves (a) diagnosis, (b) prevention by sanitary measures, and (c) vaccination and eradication. Some of the diseases occasion exceedingly heavy losses through high mortality and others are disabling and greatly reduce production or lower ability to perform work. The monetary loss resulting from condemnation of whole carcasses or parts of diseased animals slaughtered under Federal or other official meat inspection regulations is conservatively estimated to amount to many millions of dollars.

Livestock and poultry are affected by external and internal parasites that are acquired through (a) the contamination of pastures, dry feed, and water with the infective stages; (b) through swallowing of insects and other low forms of life in which the infective stages normally live; (c) through insects that sting or bite the skin and thereby introduce parasitic infection; and (d) through direct contact of healthy animals with those that are parasitized. Once introduced into a herd or flock parasites multiply at enormous rates and produce stunting, unthriftiness, and death losses. It has been the common experience of livestock producers that farm animals cannot be raised successfully without resorting to periodic drenching or other treatment with medicinal preparations and making provisions of some sort for rotation or other methods of controlling stomach and intestinal threadworms, tapeworms, lungworms, nodular worms, liver flukes, coccidia and other minute protozoan parasites. Experience has shown that enormous quantities of feed are wasted annually in unsuccessful attempts to fatten parasitized stock and poultry. A considerable part of the condemnation of carcasses and parts under meat inspection procedure is due to parasitic invasion, and among the most serious injuries to hides are those inflicted by various external parasites.

General Plan: Investigations are made into methods of diagnosis, cause, mode of transmission, and methods of prevention, treatment, and control of the more important infectious and non-infectious diseases of livestock including poultry. These investigations embrace field and laboratory activities. Studies of the diseases as they exist in the field are made, and the bacteriological, serological, pathological, immunological, and animal inoculation studies are conducted in the laboratory.

To develop a practical and scientific basis for eradicating or controlling parasites, studies are conducted on the distribution of these pests in the major agricultural regions of the United States, these investigations taking into consideration climate, soil types, pastures, and topography; methods are developed for accurate diagnoses; the infective stages are investigated with a view to developing methods for their destruction; the mode of transmission is determined by experiments in the laboratory and observations in the field; the injuries produced and symptoms exhibited by experimentally-infected animals are noted in order to develop sound methods for field diagnosis; the immunological responses, if any, are investigated as aids in control; weak links at which the vicious cycles of parasites may be broken are explored; intermediate hosts are investigated and methods are devised for their eradication or control; field tests to develop promising control measures are conducted on a small scale under conditions that enable the investigators to determine the factors that might be involved; and, finally, the most promising control measures are tested in the field in cooperation with farmers and stockmen, and control measures are adapted to meet varying conditions existing in different parts of the country.

To meet the ever-pressing need for affording infected animals prompt relief from the drain of parasitic infestations and saving the lives of young animals that have but little resistance to cope with mass attacks by parasites, experiments are conducted with drugs and chemicals to

determine effective and inexpensive methods of destroying external parasites on, and removing internal parasites from, livestock and poultry. Investigations are conducted also to develop practical methods of destroying the infective stages of parasites in the manure, which is the most fertile source of parasitic infestation on the farm and range.

Examples of Progress and Current Program: The following examples of recent accomplishments and aspects of the broader problems involved are cited by projects.

Investigations of brucellosis (contagious abortion) of livestock: The progress made during the past several years in controlling *Brucella abortus* infection (Bang's disease) in cattle has been most encouraging. An important contribution has been the wide acceptance of Strain 19 vaccine developed in our laboratories at Beltsville, Maryland. This is an effective agent for inducing resistance to the disease and can be safely used in healthy as well as infected herds.

Bureau policy has continued to limit the use of the vaccine to calves, inasmuch as agglutination titers have shown a tendency to be more persistent in adult animals and, therefore, may confuse the interpretation of blood tests used for the detection of the disease. Despite this fact, reports from the field show an increasing volume of adult vaccination being practiced throughout the country. These reports are most enthusiastic about the favorable results obtained, and have led to a growing popular demand for inclusion of this procedure as a recognized part of the vaccination program. In anticipation of this trend, experimental studies relative to the value of adult cattle vaccination have been intensified during the past three years. At the present stage of these investigations the resistance induced by vaccination seems to be comparable with that stimulated in calves. As a matter of fact, the only exception so far noted, has been the persistence of blood agglutination titers following injections. Should this prove to be the only disadvantage, it is quite possible that this procedure could be recognized as a valuable control aid for use in those herds in which recent exposures have introduced a highly virulent form of the disease.

Investigations dealing with *Brucella suis* infection in swine have continued as a cooperative project with five State experiment stations. In view of the urgent needs for increased meat production, this work is being carried out on a wartime emergency basis. Transmission experiments have emphasized the great importance of the infected boar in spreading swine brucellosis. Approximately 70 percent of the gilts experimentally bred with known infected boars have contracted the disease. The frequency with which extremely early abortions occur with this type of exposure, suggests a possible explanation for some of the difficult breeding histories reported from herds in which the disease exists. It is quite possible for abortions occurring within the first 6 weeks of pregnancy to pass unobserved. In this event, the natural explanation would be faulty breeding, rather than specific infection. The common localization of the infection throughout the genital tract of the boar, is in direct contrast with the infrequency that genital infection with *Brucella abortus* has been found in bulls.

Another point of contrasting significance in comparison with *Brucella abortus* infection in cattle, is the apparent high susceptibility of very young stock. Repeated blood examinations carried out on pigs born to infected sows have shown that the infection may persist as a septicemia for several months after isolation on clean premises. This fact has not been fully appreciated heretofore, and will necessitate certain modifications in control recommendations.

Immunological studies covering the experimental use of vaccines for the control of swine brucellosis justify the opinion that an active resistance to this disease can be artificially induced. Although *Brucella abortus* strain 19, the vaccinal culture used for the control of bovine brucellosis, has been found ineffective in producing a serviceable degree of resistance in swine, further work with a *Brucella suis* strain of comparable virulence has given far more encouraging results. Although these results are preliminary in nature and inconclusive at this time, they are sufficiently promising to justify further work along similar lines.

Investigations of infectious diseases of livestock and poultry caused by bacteria and fungi, other than brucellosis: In accordance with the program adopted in 1942, studies were carried out along several different lines in an attempt to account for NVL reactors (animals that react positively to the tuberculin test but show no visible lesion of tuberculosis on post-mortem) and thereby prevent the slaughter of non-tuberculous reactors. Two diseases (actinomycosis and actinobacillosis) were eliminated as possible causes. In laboratory studies, infection with *Corynebacteria* (which cause abscesses and other lesions) was eliminated as a cause. Since NVL reactors may possibly be infected with acid-fast organisms other than *Mycobacterium tuberculosis* of the bovine type, attempts were made to devise methods of identifying such organisms. For this purpose, different types of organisms were grown in cultures and from the different cultures purified products, including purified tuberculin, were prepared and tested on animals sensitized to different bacteria. Laboratory tests on guinea pigs indicated that the infecting agent might be detected with a fair degree of certainty. Tests on cattle are in progress.

In further attempts to find possible substitutes for the increasingly scarce asparagin used in preparing tuberculin, a series of tuberculins were prepared from cultures grown on an ammonium glutamate medium and tested on laboratory animals. The tuberculins prepared from the glutamate medium were practically as potent as those prepared from the asparagin medium.

Research on bovine mastitis (caked bag or garget) is most important at this time when milk production is so essential, and every effort should be made to discover or develop methods of combating this disease. The second year's work on the effectiveness of various chemotherapeutic agents in many naturally infected herds continues to show that practically 70 percent of infected animals may be cured if the treatment is given to the cow when in the milking line, and in about 80 percent of cases if given when the cow is dry. From this basic work a method of eliminating

mastitis, based on a minimum of three treatments and the elimination of animals not responding to these treatments, is being tried. Chemotherapy has been found to be effective chiefly against the streptococcal form of mastitis. Another form which is probably more severe but not so common, is caused by staphylococci. In this form, entire quarters of the udder may be destroyed and many times it results in septicemia and the death of the animal. During the past year, research work on this type of mastitis showed that staphylotoxoid produced no curative effects, but that the toxoid had a tendency to localize the infection.

The recently discovered antibiotic substance, penicillin, obtained from the mold Penicillium notatum, would appear to have a practical application in the treatment of mastitis, and especially so in the staphylococcal type. The ground work for such research has been started. A representative of this Bureau recently visited the Northern Regional Research Laboratory at Peoria, Illinois, where the basic research on penicillin is being conducted. The various methods for the preparation and assaying of this product have been learned, and plans are being developed for the testing of penicillin in mastitis if and when a sufficient quantity becomes available.

Swine erysipelas, a destructive bacterial disease, now ranks next in importance to hog cholera. From July 1, 1942, to May 30, 1943, 18,199 swine herds, representing 1,368,946 swine, were treated by the simultaneous method of vaccination against erysipelas in Nebraska, Iowa, South Dakota, Missouri, Illinois, and Kentucky. The vaccine and the serum were prepared by commercial biological establishments and were distributed to veterinarians in the above-mentioned States under cooperative agreements with the livestock sanitary officials of the various States. This project is still on an experimental basis. In general, reports on this work have been quite satisfactory, and accumulating evidence indicates that this method of controlling swine erysipelas in the heavily infected areas is productive of good results.

Recognizing the possibility of increasing the egg and poultry meat supply through improving poultry livability, the Bureau of Animal Industry took steps early this year to set up a poultry viability program bringing to the attention of the commercial poultryman, the poultry breeder, the hatcheryman, and the farm flock owner known means of preventing excessive mortality.

In studies of the control of pullorum disease of poultry, seventeen lots of "K" antigen for testing chickens have been produced in the past year. These have been tested extensively in our laboratories and found to be somewhat more rapid than the T.G. antigen released for production in 1941, and to give more pronounced reactions with low-titer birds. The "K" antigen is perhaps even more successful than the T.G. antigen in eliminating pin-point reactors, and, as far as our experiments go, has better keeping qualities. The "K" antigen for testing chickens has been sent out to 21 investigators. According to reports, 11 have not tested the antigen, two replies stated that the "K" antigen was as good as the T.G., and eight have been distinctly favorable and confirmed our findings in detail. Licensed producers will in the near future be

furnished with the formula and requested to prepare trial lots. A number of lots of "K" antigen for turkeys also have been prepared and tested. The results have not been as satisfactory as those obtained with "K" antigen for chickens. However, results with "K" antigen have been more satisfactory than those obtained with other rapid antigens and although "K" antigen for turkeys gives fewer reactors than the tube test, there are some indications that it may be more specific. The work is being continued.

Investigations of infectious diseases of livestock and poultry caused by viruses: In a study of the types of virus operating in the 1942 outbreak of equine encephalomyelitis, a peculiar strain was recovered from the brain of an Arizona horse. The original brain material and first passage of the virus in guinea pigs proved to be lethal to guinea pigs but not to mice, and succeeding passages failed to produce disease in either Eastern or Western immune guinea pigs or mice. After 13 passages of the virus in chicken embryos, it quite consistently killed Eastern immune guinea pigs but not Western immunes. Further tests with vaccines prepared from this strain showed it to be of true Western type virus. This is the first time virus has been positively identified in Arizona.

For many years the only effective method of protecting hogs against hog cholera was immunization with serum and virus. This method, although effective, is recognized as having certain disadvantages, and, to eliminate these, research workers in the Bureau have developed a new product--crystal-violet vaccine. This vaccine has been extensively produced and tested under field conditions during the last several years. This work has indicated the need for improving the resistance of the product against contamination. Vaccines produced by the regular method--treating hog-cholera virus with crystal violet and disodium phosphate--are not always sterile. Furthermore, because of the somewhat limited germicidal action of the attenuating agents used, contaminants that may gain access to this type of vaccine during use may multiply. Whether originally present in the virus blood or later accidentally introduced, contaminants are undesirable since they may produce unfavorable reactions in the treated pigs and may also cause deterioration of the vaccine with consequent loss of potency. Recently it was found that a mixture of crystal violet and glycerol was more germicidal than a mixture of crystal violet and phosphate. Results of work still in progress indicate that crystal-violet-glycerol vaccines retain their potency for at least 6 months. Sufficient time has not yet elapsed to determine whether the immunity conferred by these vaccines is as durable as that conferred by crystal-violet-phosphate vaccines.

From further studies on the transmission of equine infectious anemia, it has been found that colts, ranging in age from sucklings to 2-year-olds, are as susceptible to the infection by subcutaneous inoculation as adult horses. During the past year it was found that the milk of the infected mares used in this project contained the virus and produced the disease when injected into susceptible horses, although conclusive evidence was not obtained to indicate that suckling colts may acquire the infection through the milk of their infected dams. Attempts to transmit the disease by oral administration of large amounts of urine from infected animals were negative, as were injections of this material and injections of

filtered saliva. Studies also brought out that the blood of a newborn foal of an infected mare contains the virus of swamp fever.

During the fiscal year 1943, the brains of 32 dogs suspected of rabies were examined for the presence of this disease by a variety of laboratory methods. Nineteen of the 32 dogs were found to be affected. In an effort to determine the relative efficiency of the various methods of laboratory diagnosis, a majority of the cases examined were subjected to a complete routine of diagnostic procedures consisting of microscopic examination of touch preparations, histopathological examination, and mouse inoculation tests. The conclusion drawn from the limited work done is that histopathological examination is a somewhat more efficient method for diagnosing rabies than the touch preparation method.

During the year a serious outbreak of vesicular exanthema of swine occurred in California in garbage-fed hogs. Field investigations revealed 97 infected premises with 274,051 hogs involved in 18 counties. The similarity of the clinical manifestations of this disease to those of foot-and-mouth disease makes it imperative that practical and rapid means of diagnosis be available. Laboratory work showed that the hamster and the pig are susceptible, while the guinea pig and cattle and other ruminants are not. Likewise, the virus is intermediate in size between that of etomatitis and that of foot-and-mouth disease. These facts are helpful in making a diagnosis with particular reference to differentiation from foot-and-mouth disease, but other differential features should be sought. Garbage has been implicated as the main source of infection. Control measures are quarantine and sterilization of garbage. Investigation should be carried further so that other means of control may be available and eventual eradication accomplished.

Investigations of non-infectious diseases of livestock and poultry:

Eupatorium wrighti, a plant distributed from central New Mexico to western Texas, this year was shown to be the cause of extensive cattle losses. It is now possible in many cases to avoid loss by fencing off the dangerous areas rather than by moving the cattle off those ranges during the critical periods. Corydalis aurea was found to be toxic. This plant has a rather wide distribution in central and northern New Mexico. Psilostrophe sparsiflora has been under investigation for two years, and the work is practically completed. Like other species of this genus, the plant is quite toxic and has caused rather extensive losses, especially in northern Arizona.

Vitamin A deficiency in beef cattle has been shown to result in reproductive failure in cows, birth of weak calves which often die or become blind, impotency in bulls, incoordination, and swelling of the legs, brisket, shoulders and other parts of the body. Studies to determine the requirements for reproduction have supplied evidence that 2.3 milligrams or less of carotene per 100 pounds body weight is insufficient while 2.7 milligrams or more is required to permit the birth of calves which are normal or nearly so.

Changes in the musculature of swine, known as hyaline degeneration, and also as "pale muscles" or waxy degeneration, have been recognized and studied for a number of years, but the cause has not been definitely determined. The belief that its presence indicates a toxic state has resulted in the condemnation of a considerable number of carcasses over a period of years. From recent observations it now appears highly probable that the condition affecting hogs is the result of a nutritional deficiency. An effort is now being made to determine, if possible, the exact nature of the dietary deficiency.

Investigations of protozoan parasites of livestock and poultry, including coccidiosis: Anaplasmosis--a blood disease of cattle--was investigated from the standpoint of finding a drug or drugs that will destroy the causative organisms that enter the red blood cells and produce a severe anemia. A method was developed for gaging the value of trial treatments by determining the extent to which these treatments check the multiplication of the organisms. Fowler's solution (an arsenical) was tested in 9 cattle suffering from anaplasmosis. The injection of the solution slowed up the reproductive rate of the organisms and thereby checked the destruction of the red blood cells. Other promising drugs, including neoarsphenamine, tryparsamide, sodium iodide, and quinine sulphate, were tested with promising results.

In investigations of bovine trichomoniasis, a venereal disease of cattle, the principal aim was to improve existing methods of diagnosing this infection in bulls. Since transmission occurs through breeding, the disease can be eradicated by eliminating infected bulls from breeding herds. The results showed that the accuracy of the diagnosis can be materially improved by sedimenting from 1 to 3 hours the washings obtained from the prepuce. Efforts were made, moreover to determine the precise localization of the causative organism in the bull in order to determine where treatment should be applied. In 4 infected bulls that were investigated the organisms were found to be most abundant on the head of the penis. Although a number of antiseptics were found that readily destroy these organisms in cultures, none has been found yet that is effective in destroying them in the prepuce.

In investigations of trichomoniasis of turkeys--a disease of the lower digestive tract that produces a mortality up to 50 percent or more--various medicinal preparations frequently used by turkey growers were tested and found to be ineffective. The most widely used drugs, namely, ipecac and catechu, were found to reduce the infection levels for only 3 to 4 days. Thereafter the disease took its normal course and was just as severe in the treated birds as in the untreated ones. Of the other drugs so far tested, none has been found to possess a good curative value.

Investigations conducted during the year showed that coccidiosis produces severe sickness and death in sheep even before the organisms can be demonstrated in the droppings. In sheep dying during the early stages of the disease, the lower part of the small intestine is studded with numerous globular bodies. This discovery will make it possible to diagnose early coccidiosis in sheep by a post-mortem examination of the first few animals that succumb. Although chemical prevention by

feeding sulphur showed some promise of checking coccidiosis in sheep, it is planned to test more potent drugs, including sulfaguanidine and other compounds that are related to sulfanilamide.

Investigations of worm parasites of livestock and poultry, such as tapeworms, flukes, and roundworms: Tests have been conducted with horses to determine whether blood worms and related parasites, that produce colic, lameness, and otherwise impair the working efficiency of these animals, can be controlled by small daily doses of phenothiazine administered with the feed. It has been found that 2 grams of the drug daily with the feed is quite effective in small horses but that a little more of the drug is needed for larger horses. The precise amount needed has not yet been determined. Investigations have also been made to determine whether these parasites can be controlled by making available to horses salt medicated with phenothiazine. Indications are that mixtures consisting of 29 to 39 parts of salt and one part of phenothiazine will be reasonably effective for this purpose. Since equines appear to be highly susceptible at times to phenothiazine, it remains to be seen whether the prolonged intake of the medicated salt will produce any ill effects on them.

Investigations on nodular worms--parasites that render sheep intestines unfit for conversion into surgical sutures (catgut) needed for sewing up wounds and for ligatures--show that affected sheep suffer from faulty nutrition, because the damage to the intestinal lining interferes with the absorption of food. The resultant malnutrition produces, in turn, marked disturbances in health and consequent impairment of vigor, stunting, emaciation, and death. Heavily infested sheep yield wool and meat inferior in quality and quantity, besides having intestines that are unfit for conversion into catgut. It has been determined that the eggs and larvae of these parasites are killed on pastures during the winter. The only source of infection for the lambs the following spring exists, therefore, in the breeder stock. Methods have been developed for winter treatment of ewes with phenothiazine. It has been found that this drug can be incorporated in milk, or in a 4-percent suspension of flour and water, these ingredients being available on farms and much cheaper than other suspending media used heretofore.

In studies on the effects of intestinal threadworms on pigs it has been determined that these animals acquire the parasites by lying down in contaminated litter, or by eating feed or drinking water that has become contaminated with the droppings of infested swine. The symptoms noted are loss of appetite, falling out of hair, soreness of muscles, diarrhea, intestinal hemorrhage, and severe emaciation. The parasites invade the flesh, heart muscle, body cavity, lungs, testes, brain, and spinal cord. It has been demonstrated, moreover, that boars exposed to the infection are either unable to breed altogether or fail to impregnate many of the sows with which they are mated. Observations made in the South show that heavy infections with these parasites, naturally acquired on pastures, retard the growth of pigs, and that once acquired the parasites persist in the animals for a long time. Deaths and unthriftiness of pigs on farms have been traced to this parasitic infection.

A mixture of 1 part of phenothiazine with 60 parts of mash was placed before relatively large flocks of chickens in an effort to control cecal worms, parasites responsible for the transmission of blackhead. This medicated mixture was consumed in about 6 hours and over 98 percent of the cecal worms present were eliminated from the birds. Experiments showed that the crop worm of chickens and turkeys is transmitted to these birds as a result of consuming earthworms that harbor the larval stages of the parasite.

Investigations of miscellaneous parasites of livestock and poultry: In experiments on the destruction in beef of tapeworm cysts--parasites that are transmissible to man--it has been found that when the carcasses are held for 6 days at a temperature of 15° F. the parasites in the interior of the meat are not destroyed. Even after an exposure to 15° F. for 8 days, some of the tapeworm cysts still show signs of life. Experiments are under way to determine the minimum period during which carcasses must be held under the refrigeration named to render them safe for human consumption.

Studies have been made on the muscle parasites of hogs known as sarcocysts, organisms that are sometimes present to such an extent as to necessitate condemnation of entire carcasses or parts of carcasses under meat inspection procedure. It has been determined that when pigs eat the parasitized meat of other pigs they develop severe digestive upsets, but do not develop an infection of the muscles. However, the pigs so infected eliminate with their droppings certain stages of the parasite which develop in the muscles of hogs that eat feed or drink water contaminated with such droppings. It has been assumed that when pork containing these parasites is cured, the products, especially hams and shoulders, are inferior in quality and appearance and are designated as "mushy" in meat packing establishments. It is planned to conduct investigations to determine whether the parasites are actually the cause of the mushy condition and whether the curing methods could be so improved as to prevent it.

The Index Catalog of Medical and Veterinary Zoology has been utilized very extensively during the past year to supply information to the Army and Navy on the kinds and distribution of parasites of man and domestic animals in the theatres of war where our armed forces are stationed. It has been used, moreover, by Army and Navy personnel for mapping the distribution of parasites and parasitic diseases throughout the world. Related information contained in the catalog has been furnished to various civilian war agencies in connection with the lend-lease program and in connection with research on tropical medicine to safeguard the health of our armed forces in the tropics.

Investigations of treatments for parasites of livestock and poultry: Tests have been made with nearly 10,000 farm and range sheep to develop an inexpensive dip for the destruction of sheep ticks. The dip is prepared by adding 4 to 6 ounces of cube powder to each 100 gallons of water. When sheep are dipped once in this preparation, the ticks disappear in a relatively short period and the sheep remain free from ticks

for a long time, as determined by periodic inspections made over a test period of 7 1/2 months following dipping. The cost of this home-made dip is only 10 to 20 percent of that charged for commercially prepared dips.

An investigation has been conducted on nearly 400 sheep to determine whether the parasites that are most injurious to sheen can be removed by making available to the sheep phenothiazine mixed with salt. This mixture, containing 1 part of the drug and 9 parts of salt, was voluntarily eaten by sheep. After a period of 4 to 5 weeks most of the parasites harbored, including stomach worms, hookworms, and nodular worms, were removed from them. Sheep that had access to the medicated salt for as long as 2 years showed no impairment of fertility and lambing, and exhibited significantly greater weight gains than healthy controls that had access to salt alone. Moreover, the medicated sheep had fleece and meat of equal or better quality, character, and amount, than nonmedicated healthy sheep. As the treatment is now being used widely by sheep growers, because of its labor-saving features, its effectiveness under practical conditions will be determined during the coming year. In preliminary studies to determine whether this scheme of self-medication is applicable to goats as well as to sheep, 13 does were given access to the medicated salt. Periodic inspections showed that the treated goats were in excellent health throughout the experiment and were comparatively free of roundworms. During the period of medication the 13 does gave birth to 20 healthy kids.

In preliminary tests it has been determined that perthiocyanic acid shows promise of being safe and effective for the removal of tapeworms, and that compounds of flourine show promise of being efficacious for the removal of large roundworms from pigs. In one test 97 percent of the roundworms were removed from a group of pigs by sodium flouride. However, because of the toxicity that is sometimes observed in pigs treated with this chemical, other flourine compounds are being tested.

(d) Eradicating Tuberculosis and Bang's Disease

Appropriation Act, 1944	\$5,983,800
Budget estimate, 1945	<u>5,777,191</u>
Decrease	<u>-206,609</u>

PROJECT STATEMENT

Project	1943	1944	1945	Increase or decrease
		(estimated)	(estimated)	
1. Eradicating tuberculosis in livestock (including poultry)....	1,278,574	1,400,000	1,465,551	+65,551 (1)
2. Eradicating Bang's disease in cattle	3,805,873	4,350,000	4,311,640	-38,360 (2)
Covered into Treasury in accordance with Public Law No. 674	53,400	-	-	-
Unobligated balance	812,633	233,800	-	-233,800 (3)
Total available	<u>5,950,480</u>	<u>5,983,800</u>	<u>5,777,191</u>	<u>-206,609</u>
Transferred to other appropriations (see Budget schedules for details)	+ 88,520	-	-	-
Transferred from "Eradication of foot-and-mouth and other contagious diseases of animals"	-1,013,331	-	-	-
Prior year balance available in 1943	<u>-1,450,000</u>	-	-	-
Total estimate or appropriation	<u>3,575,669</u>	<u>5,983,800</u>	<u>5,777,191</u>	

INCREASES OR DECREASES

The net decrease of \$206,609 in this item for 1945 consists of:

(1) An increase of \$65,551 (including \$9,218 for overtime pay) under the project "Eradicating tuberculosis in livestock (including poultry)" to meet increased personnel costs due to proposed reclassifications as described in detail under the item "Meat inspection."

(2) A net decrease of \$38,360 under the project "Eradicating Bang's disease in cattle," composed of:

(a) An increase of \$127,326 (including \$17,973 for overtime pay to meet increased personnel costs due to proposed reclassifications as described in detail under the item "Meat inspection."

[Note that the following two decreases more than offset the foregoing additional funds required for reclassification.]

(b) A decrease of \$165,686 in working funds resulting from reduced activities due to the present manpower situation and a consequent decrease in animals tested.

(3) A decrease of \$233,800 which represents the estimated unobligated balance in 1944 not required in 1945.

Resume of Financing and 1944 Allotments:

Tuberculosis eradication has been in progress since 1917. During the fiscal years 1935 to 1938, inclusive, regular and special funds (Jones-Connally and Section 37, Act of August 24, 1935) were used for this purpose. Bang's disease eradication was inaugurated in the fiscal year 1935, and this work was financed exclusively with special funds through the fiscal year 1938. Since 1939 the Agricultural Appropriation Act has provided for continuation of tuberculosis and Bang's disease eradication under one consolidated appropriation item entitled "Eradicating tuberculosis and Bang's disease."

Table 1, which follows, shows the direct appropriations, reappropriations of regular and special funds, and net availability under the consolidated item.

TABLE I

Statement of Direct Appropriations, Reappropriations of Regular and Special Funds, and Net Availability under "Eradicating Tuberculosis and Bang's Disease." Fiscal Years 1939-1945.

Fiscal year	Direct appropriation	Reappropriation	Total appropriation	Amount re-appropriated in subsequent years	Net availability
1939	\$5,403,000	\$7,827,000	1/ \$13,230,000	\$4,000,000	\$9,230,000
1940	8,300,000	4,000,000	1/ 12,300,000	5,450,000	6,850,000
1941	4,300,000	4,000,000	1/ 8,300,000	750,000	7,550,000
1942	5,598,140	750,000	2/ 6,348,140	- -	6,348,140
1943	3,575,669	2,467,331	3/ 6,039,000	- -	6,039,000
1944	5,983,800	- -	5,983,800	- -	5,983,800
1945 est.	5,777,191	- -	5,777,191	- -	5,777,191

1/ Estimated unexpended balance of special funds (Jones-Connally and Section 37, Act of August 24, 1935).

2/ Unobligated balance of 1941 funds under this head.

3/ \$1,450,000 unobligated balance of 1940 funds under this head and \$1,013,331 unexpended balances of appropriations heretofore made for "Eradication of Foot-and-Mouth and Other Contagious Diseases of Animals."

Table II, which follows, shows by states and territories, the allotments of funds for tuberculosis and Bang's disease during the fiscal year 1944.

TABLE II

Eradicating Tuberculosis and Bang's Disease

1944 Allotments

State	Eradicating tuberculosis		Eradicating Bang's disease		Total
	Salaries:	Indemni-	Salaries:	Indemni-	
	and expenses:	ties	and expenses:	ties	
Alabama	\$23,500	\$500	\$85,000	\$72,000	\$181,000
Arizona	4,000	1,000	20,000	3,000	28,000
Arkansas	6,000	0	85,500	22,500	114,000
California	116,562	14,500	4,188	0	135,250
Colorado	8,225	3,500	26,175	0	37,900
Connecticut	28,000	10,000	20,000	40,000	98,000
Delaware	5,000	1,000	11,000	11,000	28,000
Dist. of Col.	44,963	0	116,389	0	161,352
Florida	15,500	500	60,000	26,000	102,000
Georgia	7,000	0	57,000	20,000	84,000
Idaho	10,500	500	35,000	21,300	67,300
Illinois	26,593	28,000	58,280	35,000	147,873
Indiana	38,163	6,000	24,488	0	68,651
Iowa	36,197	35,000	70,092	150,000	291,289
Kansas	23,075	4,000	44,725	3,000	74,800
Kentucky	14,400	1,000	31,200	10,000	56,600
Louisiana	11,000	1,000	46,000	25,000	83,000
Maine	16,000	1,000	32,000	88,700	137,700
Maryland	29,500	6,500	66,000	80,000	182,000
Massachusetts	27,000	10,000	0	0	37,000
Michigan	26,400	12,000	81,200	60,000	179,600
Minnesota	24,660	4,000	113,980	60,000	202,640
Mississippi	19,000	2,000	38,000	20,000	79,000
Missouri	18,803	1,000	69,408	42,500	131,711
Montana	20,500	500	18,000	8,000	47,000
Nebraska	22,100	1,000	27,300	12,000	62,400
Nevada	6,500	500	9,000	0	16,000
New Hampshire	9,000	2,000	45,000	105,000	161,000
New Jersey	20,194	9,000	12,721	19,860	61,775
New Mexico	2,500	500	37,000	5,000	45,000
New York	46,138	55,000	25,413	65,000	191,551
North Carolina	9,600	400	28,000	6,000	44,000
North Dakota	21,500	500	80,000	25,000	127,000
Ohio	18,888	10,500	67,662	140,000	237,050
Oklahoma	11,575	1,000	36,725	0	49,300
Oregon	16,000	5,000	55,000	32,000	108,000
Pennsylvania	20,712	35,000	102,138	400,000	557,850
Rhode Island	10,500	1,500	1,000	3,000	16,000
South Carolina	7,500	500	19,000	5,000	32,000

TABLE II

Eradicating Tuberculosis and Bang's Disease - Continued

State	Eradicating		Eradicating		Total
	tuberculosis		Bang's disease		
	Salaries :	Indemni-	Salaries :	Indemni-	
	and expenses :	ties	and expenses :	ties	
South Dakota	\$38,888:	\$2,500:	\$20,162:	\$5,000 :	\$66,550
Tennessee	23,800:	1,200:	26,000:	30,000 :	81,000
Texas	31,706:	3,000:	30,619:	0 :	65,325
Utah	12,000:	6,000:	38,000:	0 :	56,000
Vermont	10,500:	2,500:	15,000:	1,000 :	29,000
Virginia	23,000:	6,000:	37,000:	75,000 :	141,000
Washington	25,000:	2,000:	70,000:	80,000 :	177,000
West Virginia	17,000:	1,000:	40,000:	15,000 :	73,000
Wisconsin	40,258:	17,000:	105,775:	347,000 :	510,033
Wyoming	6,700:	300:	18,300:	700 :	26,000
Alaska	0:	100:	0:	0 :	100
Hawaii	1,900:	500:	0:	0 :	2,400
Puerto Rico	31,000:	7,000:	10,000:	10,000 :	58,000
	:	:	:	:	
	:1,085,000:	315,000:	2,170,440:	2,179,560:	5,750,000

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$221,732:	\$409,803:	\$409,803
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	- -	- -	27,191
Total cost of overtime(7 months in 1943):	221,732:	409,803:	436,994

WORK UNDER THIS APPROPRIATION

Objective: The eradication of tuberculosis in livestock (including poultry), paratuberculosis in cattle, and Bang's disease (brucellosis or contagious abortion) in cattle, with partial compensation to owners of cattle condemned and destroyed because of being affected with the diseases.

The Problem and its Significance: Tuberculosis is one of the most serious diseases of cattle, swine, and poultry, because of its effect in reducing production and causing a considerable loss of meat condemned as unfit for food. Notwithstanding the great progress made in stamping out this disease, it is reliably estimated that an annual loss of \$10,000,000 can be attributed to it, \$5,500,000 of which is borne by the poultry industry, \$2,000,000 by the swine industry, and \$2,500,000 by the cattle industry. In swine it may progress to a point where it becomes generalized, but in most of the carcasses showing evidence of the disease on post-mortem examination, only slight lesions are found. Avian (fowl) tuberculosis is particularly difficult to eradicate because of the fact that the organisms are so resistant and live for many months in the soil.

Bang's disease is found among cattle in practically all sections of the United States, although the degree of infection is much greater in some localities than in others. In those sections where there has been a considerable exchange of cattle, a high degree of infection is found. This condition also obtains in and around the large milk-shed areas. It is conservatively estimated that this disease is responsible for an annual loss of \$30,000,000 to our livestock industry. Approximately 75 percent of all breeding trouble in cattle is caused by this disease. Common results of the infection are premature birth of calves and sterility.

General Plan--Cooperation with States: Eradication work is conducted in cooperation with livestock sanitary officials of the various States, and is governed by state laws and regulations. Tuberculosis eradication is carried on under the test-and-slaughter plan, but cooperating States may elect one or more of the three plans for Bang's disease eradication: (a) Test-and-slaughter plan, (b) calfhood vaccination, or (c) a combination of the two.

Under the test-and-slaughter plan, tests are applied to the cattle by veterinarians employed by the Bureau, states and counties, and by practicing accredited veterinarians, to detect the existence of any infection in the living animal. Reactors are appraised at their market value, taking into consideration their quality as breeding and dairy animals, after which they are slaughtered under supervision. In addition to their salvage value, the owner receives from the Federal Government one-third of the difference between the appraised value and the salvage, not to exceed \$25 for grade animals and \$50 for registered purebred animals. Federal payment is further limited to an amount not exceeding that paid by the cooperating state, county, and municipality. Payment from all sources, including the salvage, cannot exceed the appraised value of the animal.

Under the calfhood vaccination plan, all cattle over 6 months are usually tested. The vaccination of animals is confined to calves between 4 and 8 months of age, 6 months being the preferable age. The age and date of vaccination of each animal is properly recorded, and the identity of each animal definitely established. Animals in herds in which vaccination is practiced are not to be disposed of, except for immediate slaughter, without written permission of the cooperating state or Bureau officials. A herd under the vaccinal plan

may be certified as a "herd Free of Brucellosis" for a period of 1 year when all animals in the herd over 2 years of age reveal at least 2 negative reactions to official blood agglutination tests, properly spaced, and the vaccinated animals under 2 years of age show a satisfactory blood titer. The payment of Federal indemnity for adult cattle in such herds that react to the test depends upon the circumstances in the individual states.

As stated above some states employ a combination of the test-and-slaughter plan and calfhood vaccination plan, the owner selecting which plan is to be adopted. Inasmuch as the success of any eradication plan depends, to a large extent, upon the conditions prevailing in the individual states the Bureau has taken such conditions into consideration in the officially recognized plans.

Supervision is maintained over the disposition of reactors which have been consigned to public stockyards for slaughter, and over the testing at such stockyards of cattle to be shipped interstate for dairy or breeding purposes.

In combating avian tuberculosis, the veterinarians employed in the field cooperate with the local livestock sanitary officials and the owners of poultry flocks. Cooperation is also obtained from certain local organizations and owners of hatcheries.

Examples of Progress and Current Program: At no time in history has the importance of domestic animals attracted as much attention as during the present crisis, nor has the application of veterinary science ever been as highly appraised as a war-time or preparedness measure. To accomplish increased food production of animal origin, it is vitally important that we conserve the health of our livestock. The work under this appropriation involves the testing of cattle for tuberculosis and Bang's disease, the removal of reactors and the cleaning and disinfecting of premises. Reduction in animal diseases, permitting more economical production of livestock, means additional millions of pounds of meat and dairy products as well as many other animal products.

Eradicating tuberculosis in livestock (including poultry): Since the inauguration of the cooperative tuberculosis eradication work in 1917, there has been a very marked reduction in the degree of infection of tuberculosis. At the beginning of the campaign approximately 5 percent of the cattle tested disclosed infection, whereas during the fiscal year 1943 less than two-tenths of 1 percent reacted to the test. All counties in every State, the District of Columbia, Puerto Rico, and the Virgin Islands, are now listed as modified accredited areas. Since the cooperative work was undertaken, through the fiscal year 1943, approximately 262,235,000 tuberculin tests have been applied to cattle, disclosing about 3,854,000 reactors.

During the fiscal year 1943 the average appraisal of reactors was \$135.19; the average salvage, \$65.03; the average state indemnity, \$27.50; and the average Federal indemnity, \$18.75. It will thus be noted that on an average appraisal of \$139.19, the owner received from all sources for his tuberculous animals a total of \$111.28. On June 30,

1943, 6,317,670 herds, containing 63,846,496 cattle were under supervision for the eradication of tuberculosis.

During the past year the field veterinarians engaged in tuberculosis eradication work observed approximately 52,000 flocks, containing about 7,558,000 fowls located in 9 states. About 14 veterinarians of the Bureau devoted practically their entire time to the avian tuberculosis project, visiting 7,536 farms, and observing 1,312,092 fowls. Infection was reported on 1,248 farms.

Paratuberculosis, or Johne's disease, exists to some extent among cattle in the United States. While this is a difficult disease on which to make a diagnosis, 4,877 cattle were tested during the past year, disclosing 247 reactors, or 5.0 percent.

All the tuberculin used in this work is prepared by the Bureau. During the past fiscal year approximately 947,000 cc. of this product were used in the work.

Eradicating Bang's disease (brucellosis) in cattle: Since the cooperative campaign for the eradication of Bang's disease in cattle was undertaken in July 1934, very satisfactory progress has been made. The incidence of this disease among the dairy and beef cattle of this country has been reduced from approximately 10 percent in 1934 to about 4.5 percent. In 1934 the annual loss on account of the disease was estimated to be perhaps \$50,000,000, whereas, due to the progress made in eradication measures, it is now estimated to be about \$30,000,000. There is a great demand on the part of the cattle owners that the work be continued, although there has naturally been some reduction in the volume of work due to a shortage of veterinarians, many of whom have joined the armed forces. Many States have plans for accrediting individual herds as Bang's disease free. At the close of the fiscal year 1943, there were about 40,000 such herds, containing about 835,000 cattle. Approximately 2,200,000 herds, containing about 16,616,000 cattle, were under official supervision for the eradication of the disease.

Soon after the beginning of the cooperative campaign for the eradication of this disease in cattle, it was decided to inaugurate a plan whereby cattle could be tested on an area basis. In December 1939, a plan was adopted to establish "modified accredited Bang's disease-free areas," that is, areas in which cattle infection does not exceed 1 percent and herd infection not more than 5 percent. As a result of work conducted to the end of the fiscal year 1943, the total number of counties in this classification was 582, located in 24 States. These counties, which are 19 percent of the total number in the United States, contain approximately 5,462,000 dairy and breeding cattle. Area work was being conducted in about 136 additional counties in 25 States. North Carolina is the first State whose entire area has qualified as modified accredited.

During the 9 years in which this work has been conducted, agglutination blood tests, including retests, have been applied to approximately 59,922,000 cattle, of which about 2,540,000 have been classed as reactors.

During the fiscal year 1943, a total of 5,185,228 agglutination blood tests were applied to cattle, disclosing 197,329 reactors, including 53,558 reactors held in calfhood vaccination herds for which Federal indemnity will not be paid. During the fiscal year 1943 the average appraisal of reactors was \$128.03; the average salvage, \$64.87; the average state indemnity, \$18.63; and the average Federal indemnity, \$16.77. The owner received from all sources for his Bang's disease reacting cattle an average total of \$107.27. On June 30, 1943, 2,199,535 herds, containing 16,616,522 cattle, were under supervision for the eradication of Bang's disease.

Satisfactory results have continued with calfhood vaccination. This work is conducted under official supervision in 43 states. From January 1, 1941 to June 30, 1943, approximately 375,000 calves were vaccinated under official supervision.

It is extremely important that careful supervision be given to the testing of all vaccine used in this work. During the fiscal year 1943, samples of 2,168 batches of commercially prepared vaccine were tested by the Bureau, 171 of which were found unsatisfactory for vaccinal purposes and ordered destroyed. Some of the Brucella vaccine used in the official calfhood vaccination work is prepared by the Bureau, as well as all of the antigen used in official Bang's disease testing.

(e) Eradicating Cattle Ticks

Appropriation Act, 1944	\$220,000
Proposed consolidation in the 1945 estimates: to "Salaries and expenses, animal industry, Agricultural Research Administration," inspection and quarantine	-220,000
Budget estimate, 1945	<u>- -</u>

CHANGE IN LANGUAGE

The estimates include a proposal involving the deletion of the language of this item, as follows (deleted matter enclosed with brackets):

[Eradicating cattle ticks: For the eradication of southern cattle ticks, \$220,000: Provided, That, except upon the written order of the Secretary, no part of this appropriation shall be used for the purchase of animals or in the purchase of materials for or in the construction of dipping vats upon land not owned solely by the United States, except at fairs or expositions where the Department makes exhibits or demonstrations; nor shall any part of this appropriation be used in the purchase of materials or mixtures for use in dipping vats except in experimental or demonstration work carried on by the officials or agents of the Bureau of Animal Industry]

More than 99 percent of the original quarantined area has been released from quarantine. The problem now is mainly one of policing to prevent reinfestation of free territory. It therefore seems appropriate to include this work as a separate project under the appropriation item "Inspection and quarantine."

(f) Hog Cholera Control

Appropriation Act, 1944	\$100,580
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	14,708
Total anticipated available, 1944	<u>115,288</u>
Budget estimate, 1945	<u>115,440</u>
Increase	<u>+152</u>

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Hog cholera control ..	\$106,452:	\$115,288:	\$115,440:	+\$152(1)
Covered into Treasury in accordance with Public Law 674	1,420:	- -:	- -:	- -
Unobligated balance	928:	- -:	- -:	- -
Total available	108,800:	115,288:	115,440:	+152
Transferred from "Salaries: and expenses, animal industry, Agricultural Research Administra- tion," eradicating tuberculosis and Bang's disease	-6,800:	- -:	- -:	
Anticipated deficiency for overtime pay	- -:	-14,708:	- -:	
Total estimate or appropriation	102,000:	100,580:	115,440:	

INCREASES OR DECREASES

(1) A net increase of \$152 under the item "Hog cholera control" for 1945 is composed of:

- (a) An increase of \$1,152 (including \$152 for overtime pay) to meet increased personnel costs due to proposed reclassifications as described in detail under the item "Meat inspection."
- (b) A decrease of \$1,000 in working funds due to a slight curtailment of expenses other than salaries in States where this service is available to the swine industry. This decrease offsets all but \$152 of the funds required for reclassification under this item.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$8,310:	- -:	- -
Additional funds for overtime (appro- priated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	- -:	\$14,708:	\$14,860
Total cost of overtime (7 months in 1943):	8,310:	14,708:	14,860

WORK UNDER THIS APPROPRIATION

Objective: To assist swine growers in preventing outbreaks of hog cholera and in controlling this highly infectious and fatal disease of swine when outbreaks occur.

The Problem and its Significance: Hog cholera is the most serious disease of swine and is found in all sections of the country. It takes the highest death toll of all hog diseases and where uncontrolled is capable of ruining the swine industry. The problem is to secure the widest application of effective preventive and control measures and thereby reduce losses from this disease; to demonstrate the importance of sanitary surroundings in preventing and controlling swine diseases; and to prevent the dissemination of swine diseases by controlling the movement of diseased swine or the exposure of healthy swine to an infected premise.

General Plan: Specially trained veterinarians are stationed in the principal swine-growing sections of the country to consult with and assist veterinary practitioners and others in diagnosing swine diseases, and through meetings and by personal contact to advise and demonstrate to farmers and others the approved methods of preventing and controlling swine diseases.

Examples of Progress and Current Program: During the fiscal year ending June 30, 1943, through their visits to farms and attendance at meetings, these veterinarians had opportunity for 49,847 farm inspections and consultations relating to swine diseases with farmers, veterinarians, state officials, and others. Educational work was continued by these veterinarians, who attended 231 meetings at which there was an attendance of 14,273 persons. During the year 6,015 outbreaks of cholera were reported to these veterinarians. These measures have greatly reduced losses from hog cholera and have prevented widespread outbreaks of this disease.

(g) Inspection and Quarantine

Appropriation Act, 1944 (includes \$220,000 transferred from "Salaries and expenses, animal industry, Agricultural Research Administration," eradicating cattle ticks)	\$881,350
Anticipated deficiency for overtime pay required under the War Overtime Pay Act of 1943	+132,575
Total anticipated available, 1944	1,013,925
Budget estimate, 1945	1,003,130
Decrease	<u>-10,795</u>

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
<u>Bureau of Animal Industry:</u>				
1. Scabies eradication	\$96,747	\$125,562	\$128,566	+\$3,004(1)
2. Control over inter- state shipment of livestock for the purpose of preventing the spread of com- municable diseases ..	331,652	353,675	363,626	+9,951(1)
3. Determination by in- spectors in the field of the existence of diseases	56,674	59,435	60,561	+1,126(1)
4. Inspection and quar- antine of import animals	105,173	117,763	120,579	+2,816(1)
5. Supervision over the importation of hides and other animal by- products, forage, etc	63,335	70,448	72,326	+1,878(1)
6. Inspection and test- ing of animals for export	3,057	3,024	3,024	- -
7. Eradicating cattle ticks	260,717	254,354	224,784	-29,570(2)
Total obligations, Bureau of Animal Industry	917,355	984,261	973,466	-10,795
<u>Food Distribution Admin- istration:</u>				
8. Enforcement of the 28-hour law	28,295	29,664	29,664	- -
Total obligations	945,650	1,013,925	1,003,130	-10,795
Covered into Treasury in accordance with Public Law 674	7,575	- -	- -	- -
Unobligated balance	24,975	- -	- -	- -
Total available	978,200	1,013,925	1,003,130	-10,795
Transferred from "Salaries and expenses, animal industry, Agricultural Research Administration eradicating tuberculosis and Bang's disease	-33,700	- -	- -	
Anticipated deficiency for overtime pay	- -	-132,575	- -	
Total estimate or appropriation	944,500	881,350	1,003,130	

INCREASES OR DECREASES

The net decrease of \$10,795 in this item for 1945 consists of:

(1) An increase of \$18,775 (including \$2,241 for overtime pay) under the first 5 projects shown in the above statement to meet increased personnel costs due to proposed reclassifications as described in detail under the item "Meat inspection."

(2) A net decrease of \$29,570 under the project "Eradicating cattle ticks," composed of:

(a) An increase of \$33,102 (including \$5,742 for overtime pay) to meet increased personnel costs due to reclassifications as described in detail under the item "Meat inspection."

(b) A decrease of \$62,672 in working funds due to reduced activities in eradicating cattle ticks.

[Note that the total decrease (\$62,672) more than offsets the additional funds (\$51,877) required for reclassifications under this item.]

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, delete matter enclosed with brackets):

Inspection and quarantine: For inspection and quarantine work, including the eradication of southern cattle ticks, scabies in sheep and cattle, and dourine in horses, the inspection of southern cattle, the supervision of the transportation of livestock, and the inspection of vessels, the execution of the twenty-eight-hour law, the inspection and quarantine of imported animals, including the establishment and maintenance of quarantine stations and repairs, alterations, improvements, or additions to buildings thereon; the inspection work relative to the existence of contagious diseases, and the mallein testing of animals, [~~\$661,350~~] \$1,003,130.

The words "southern cattle ticks" are inserted since there is consolidated with this item the activity which, since 1906, has been carried on under the item "Eradicating cattle ticks." The object of this work is to free the continental United States, Puerto Rico, and the Virgin Islands of splenic or tick fever by eradicating the cattle fever tick, which is the only natural carrier of the disease. It seems appropriate at this time to include the tick eradication work under the general item for inspection and quarantine activities. More than 99 percent of the original quarantined area has been released from quarantine and the problem now is mainly one of policing to prevent reinfestation of free territory. The principal activities are in Texas where a quarantine is being maintained in a narrow strip extending through parts of 8 counties along the lower Rio Grande. This area is being maintained as a buffer in an effort to control the introduction of ticks on smuggled or straying animals from Mexico.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	*\$80,966	\$23,579	\$23,579
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	2,500	132,575	131,146
Total cost of overtime (7 months in 1943) :	83,466	156,154	154,725

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: The eradication of scabies in sheep and cattle, dourine in horses, and the cattle fever tick, in cooperation with the various States; the investigation of reported outbreaks of diseases among livestock to determine if they are communicable and, if so, assisting local authorities in their control and eradication; the application of tests in the field and in the laboratory for diagnostic purposes; the control over interstate movements of livestock as a means of preventing the dissemination of infections, which includes inspection at the principal market centers; the administration of the 28-hour law to prevent cruelty to animals in interstate transportation; the inspection and testing of livestock intended for export, to determine their freedom from disease, and the inspection of fittings and accommodations on vessels on which they are to be transported; the inspection and quarantine of livestock offered for importation; control over import animal byproducts, hay and straw, etc., to prevent the introduction or dissemination of communicable livestock diseases; and the administration, jointly with the Treasury Department, of Section 306 of the Tariff Act of 1930, prohibiting the importation of domestic ruminants or swine, or chilled or frozen fresh meats derived therefrom from countries where foot-and-mouth disease or rinderpest exists.

The Problem and its Significance: Scabies and the other diseases covered by this item are readily disseminated and their control or eradication is important for the protection of the livestock industry.

Shipment of livestock which are affected with a communicable disease may cause other animals to become infected and thus cause severe loss to livestock owners. The discovery at public stockyards of shipments of livestock affected with communicable diseases prevents the further spread of disease and permits the infection to be traced back to its source.

It is important to safeguard the livestock industry against serious losses by preventing the introduction of destructive communicable diseases from other countries through the importation of livestock or through the medium of infected or contaminated animal byproducts, hay, straw, etc. In order to protect and promote foreign trade it is necessary to prevent the exportation of any animals that have been exposed to any communicable disease and to provide for their safe transportation.

General Plan--Cooperation with States: Disease eradication work is carried on in cooperation with the States involved. In public stockyards work an inspection force is maintained at principal market centers to prevent the dissemination of livestock diseases by detecting, segregating, and supervising the appropriate treatment or other disposal of animals affected with or exposed to contagious, infectious or communicable disease, and supervising the treatment and disinfection of all cars, trucks and other conveyances used in the transportation of infected animals, and all pens, chutes and alleys in which such animals are handled. In the import work under this item inspectors are assigned to stations along the international boundaries and on the seacoast to inspect animals, and when necessary to place them in quarantine, and to inspect animal byproducts, hay, straw, etc. In export work, animals are inspected and tested at ports and in the various districts of origin throughout the country.

Examples of Progress and Current Program:

Scabies eradication: During the fiscal year 1943, inspections and supervised dippings of sheep in the field totaled 11,679,895 and 677,253, respectively. Infection was found in 1,146 flocks, a decrease of approximately 35 percent from the previous year. About 1/3 of the infected flocks were in Louisiana where circumstances prevented systematic dipping. With few exceptions the remainder of the infection was in midwestern States. Cooperative campaigns are in progress in twelve States. The cooperative eradication program inaugurated in Illinois during the year is expected to have a stimulating effect on the work in nearby States. A few cases of reinfestation in the range areas of the West, where it appeared the disease had been completely eradicated, were promptly dealt with. A total of 1,772,288 inspections of cattle were made in the field and 111,655 dippings were supervised. The number of cattle in infected herds was 8,307, about 30 percent less than the number reported for the previous year. However, reintroduction of infection which occurs from time to time indicates that continued watchfulness will be essential so long as any infection remains in the country. Several cases of sarcoptic scab in widely separated States were also handled with Bureau assistance.

Control over interstate shipment of livestock for the purpose of preventing the spread of communicable disease: The work in connection with the inspection of livestock moving interstate does not vary greatly from year to year. It is most important that no affected animal be permitted to pass through a public stockyard and establish a new center of infection. Thus it is imperative that all animals in yards under Bureau supervision be thoroughly inspected.

The progressive increase in the transportation of livestock by motor truck rather than by railroad continued through the past fiscal year. In 1943 there were 46 cities where stations were maintained for public stockyard inspection. A total of 81,253,928 animals were inspected

including 21,421,399 cattle, 26,160,461 sheep and 33,677,068 swine. A total of 619,640 animals were dipped or immunized including 1,609 cattle, 279,075 sheep, and 338,956 swine. Infectious cars received numbered 404 and cars cleaned and disinfected 3,600. These figures do not fairly indicate the amount of work involved for the reason that more work is required in the inspection of truck shipments than in the inspection of shipments received by rail.

Determination by inspectors in the field of the existence of disease:

Work under this project consisted principally in continuing our cooperation with State authorities in ascertaining the extent of dourine in horses in Arizona, California, and Nevada, and in eradicating the disease where found. Blood samples are collected from all horses in areas involved. The serum from each sample is forwarded to the Bureau's pathological laboratory in Washington for the complement-fixation test. Animals affected as disclosed by the test are destroyed. In areas where the heaviest infection was found, several Indian reservations were involved, and on these the work was in cooperation with the Office of Indian Affairs. Most of the horses on these reservations are wild and difficult to handle under existing range conditions which materially adds to the cost of operations. Of the more than 20,000 horses tested during the fiscal year 1943 in Arizona less than 1 percent were found to be affected with the disease and destroyed. In the remainder of the areas involved tests of 8,317 horses revealed only 11 positive reactors. In continued cooperation with Mexican authorities the Bureau tested nearly 5,000 horses in areas in Mexico adjacent to territory involved in this country.

Bureau employees continued to furnish assistance in administering preventive treatment to Indian-owned cattle on reservations where anthrax infection is known to exist. Prompt and careful investigations were made of all reports of cases suspected of being foot-and-mouth disease.

Inspection and quarantine of import animals: In the fiscal year 1943 inspections at the various ports totaled 813,330, a slight decrease as compared with the previous year. Of these, 26,905 were refused entry on account of disease and 110 were detained for further observation and testing for the purpose of determining their freedom from infection. The number and kind of animals inspected were as follows:

Ports of Entry	Cattle	Swine	Sheep	Goats	Horses and mules	Asses	Other animals
Ocean ports	127	-	90	341	389	-	16
Canadian border ports	89,915	467	3,460	109	9,822	3	9
Mexican border ports	704,334	781	1,822	63	1,500	25	57
Total	794,376	1,248	5,372	513	11,711	28	82

Supervision over the importation of hides and other animal byproducts, forage, etc.: Supervision was exercised over the entry of various animal byproducts, including nearly 90,000,000 hides and skins of which over 67,000,000 proceeded from countries where foot-and-mouth disease or rinderpest exists. A total of 1,592 railway cars used in the transportation of restricted import products were disinfected, as were trucks, ship compartments, and premises involved in the handling of such products.

Inspection and testing of animals for export: During the past fiscal year 9,166 animals were inspected prior to their exportation in compliance with the regulations of the Department and in order to meet the requirements of destination countries. These included 6,005 cattle, 1,385 sheep, 529 goats, 72 swine, 1,171 equines and 4 other animals. Control was exercised over the equipment and facilities of vessels receiving export livestock to assure the provision of space and fittings necessary for humane treatment and safe transportation.

Eradicating cattle ticks: At present, the principal activities are in Texas and Puerto Rico, while control activities and check inspections are being continued in Alabama, Arkansas, California, Florida, Louisiana, and the Virgin Islands. In Florida, Hendry and Collier Counties, the last remaining quarantined area in that State, were released from Federal quarantine on December 1, 1943. In Texas, principal activities are in a narrow strip of quarantined area extending through parts of 8 counties along the lower Rio Grande. Mexican territory adjacent to this area is tick infested and the quarantined strip is being maintained as a buffer in an effort to control the introduction of ticks on smuggled or straying animals from Mexico. In Puerto Rico the work is in the final or clean-up stage. In the States of Alabama, Arkansas, California, Florida, Louisiana, and the Virgin Islands, the work consists of reinspection whenever tick infestation is suspected or reported and taking necessary control measures.

In this work, cooperating agencies during the past fiscal year supervised 7,718,789 inspections or dippings of cattle, 548,941 inspections or dippings of horses and mules, and 306,183 inspections or dippings of sheep and goats.

Enforcement of the 28-hour Law: (Food Distribution Administration). The volume of work under the 28-hour law is controlled by the number of alleged violations brought to the attention of the Department. These violations for recent years are shown in the following table:

	Fiscal Year			
	1940	1941	1942	1943
Violations reported	201:	244:	757:	1,916
Violations referred to Solicitor .	100:	182:	504:	613
Violations referred to Department of Justice	66:	217:	473:	442
Cases terminated during year	220:	121:	299:	511
Cases pending end of year	58:	154:	328:	256
Number of convictions	150:	117:	280:	455
Amount of penalties	\$15,300:	\$11,875:	\$29,750:	\$48,050

Official inspections of stockyards and railway yards were discontinued during the year because of the pressure of work caused by the large number of violations reported. Previously, inspection of stockyards and consultations with railroad officials resulted in many voluntary improvements in facilities for feeding, watering and resting livestock while in transit.

An investigation is being made at the present time into the increasing losses of meat resulting from dead and crippled animals arriving at livestock markets by truck. Such losses have increased substantially above 1942, largely because of overloading. The encouragement of heavier loading by the Office of Defense Transportation in its program to conserve truck miles and truck use, and the development of planned marketing with more efficient use of truck capacity, has apparently contributed heavily to this condition.

(h) Meat Inspection

Appropriation Act, 1944	\$7,134,079
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+1,482,987
Total anticipated available, 1944	8,617,066
Budget estimate, 1945	9,359,124
Increase	<u>+742,058</u>

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
<u>Food Distribution Administration:</u>				
1. Meat Inspection operations at packing plants under the Federal meat inspection service.....	7,544,113	8,438,411	9,180,469	+742,058(1)
2. Determination of adulterations and other objectionable conditions in meat and meat food products by laboratory analysis.....	96,383	110,714	110,714	- -
3. Inspection of imported meats and meat food products..	33,781	36,111	36,111	- -
Total obligations, FDA.....	7,674,277	8,585,236	9,327,294	+742,058
<u>Bureau of Animal Industry:</u>				
4. Chemical, pathological and zoological investigations relating to meat inspection.....	26,864	31,830	31,830	- -
Total obligations.....	7,701,141	8,617,066	9,359,124	+742,058
Covered into Treasury in accordance with Public Law 574.....	4,121	- -	- -	
Unobligated balance.....	15,738	- -	- -	
Total available.....	7,721,000	8,617,066	9,359,124	
Anticipated deficiency for overtime pay.....	- -	-1,482,987	- -	
Total estimate or appropriation.....	7,721,000	7,134,079	9,359,124	

INCREASE

(1) An increase of \$742,058 (including \$115,358 for war overtime pay) is requested under the item "Meat inspection" for reclassifying veterinarians, and lay assistants. The following explanation applies not only to the increase recommended in this item, but also to the increases for this purpose requested in the items "Eradication of tuberculosis and Bang's disease", "Inspection and quarantine", "Virus Serum Toxin Act", "Hog cholera control", and "Marketing agreements with respect to hog cholera virus and serum."

Summary of Estimated Costs and Appropriation Increases
Required for Proposed Reclassification of
Veterinarians and Lay Assistants,
Fiscal Year 1945

Appropriation Item	Estimated Costs			Appropriation increases required
	Basic salaries	War over-time pay	Total	
Salaries and expenses, Bureau of Animal Industry:				
Meat inspection a/....	\$626,700	\$115,665	\$742,365	\$742,058
Eradicating tuberculosis and Bang's disease...	165,686	27,191	192,877	- -
Inspection and quarantine.....	43,894	7,983	51,877	- -
Virus Serum Toxin Act..	6,060	1,053	7,113	7,113
Hog-cholera control....	1,000	152	1,152	152
Total, salaries and expenses.....	843,340	152,044	995,384	749,323
Marketing agreements with respect to hog-cholera virus and serum (transfer from appropriation made by section 12(a) of the AAAAct of 1933)..	1,180	257	1,437	b/ 1,437
Totals.....	844,520	152,301	996,821	750,760

a/ Relates to functions transferred to Food Distribution Administration pursuant to Executive Order 9280.

b/ Involves an increase in limitations on use of existing funds rather than an increase in direct appropriations.

Objective: To strengthen the organization responsible for safeguarding the quality of the meat and dairy products of the nation by reclassifying veterinarians and lay assistants, from existing substandard grades and wage rates to their proper grades in accordance with the standards prescribed by Section 13 of the Classification Act of 1923, as amended. By making possible the use of grade allocations contemplated by law, salaries commensurate with the compensation of other professional groups for comparable work can be paid to this group, thus insuring the retention of employees now in the service, the recruitment of replacements necessary to maintain an adequate staff, and the employment of additional veterinarians and lay assistants required to handle the increased work load brought about by an unprecedented livestock slaughter.

The Problem: The existing grade allocations of persons engaged in the work of protecting the quality of the nation's meat supply are such as to threaten the continued efficiency of the organization, and are becoming increasingly inadequate in the face of widespread manpower shortages and rising living costs. The number of persons available at present salary rates is steadily declining. During the summer of 1943, the normal slack in activity permitted a spreading of the available manpower so that service was provided where necessary. With the largest movement of livestock in history anticipated during this year and next it is imperative that additional personnel be recruited and present employees retained. The present force of veterinarians is inadequate to carry out extremely pressing wartime meat inspection demands and a protection program for our increased livestock production. Many of the veterinarians and assistants now employed are engaged in meat inspection, the prime purpose of which is to prevent, through enforcement of the Meat Inspection Acts, the shipment in intrastate, interstate or foreign commerce of meat and meat food products which are unsound, unwholesome, or otherwise unfit for human consumption. Others are engaged in tick eradication, the control and eradication of animal diseases, and inspection at livestock markets and commercial establishments producing serum, virus, etc. The knowledge and skills required in this work are highly specialized, and can be supplied only by competent and specialized personnel.

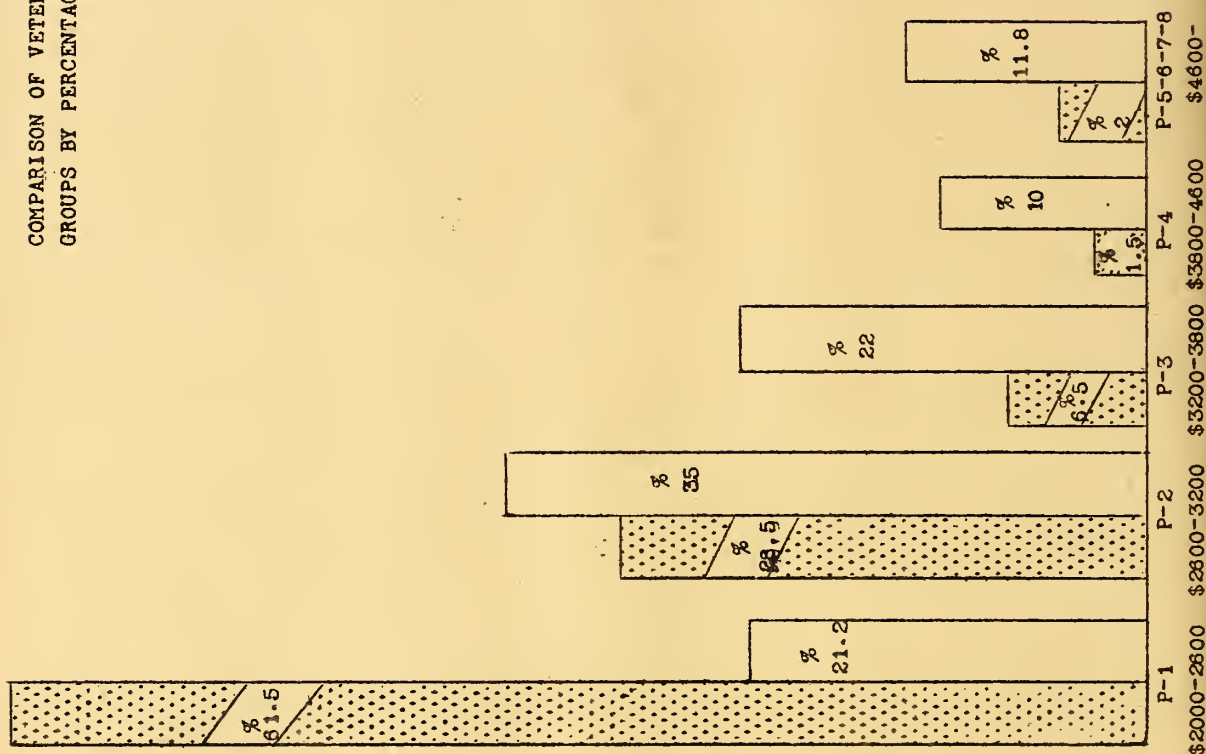
The Meat Inspection Service is operating under a severe hardship, as inspection must be extended to cover the largest livestock slaughter in history at a time when the inspection staff is declining because inspectors are attracted to war industry and other jobs at higher rates of pay.

Federal meat inspection and disease control is professional work of the most exacting kind, performed for long hours under trying and adverse conditions. Whether it is done well or badly is of the greatest importance to the people of the United States, for upon the quality of the inspection depends the healthfulness of the meat and dairy products supply of the nation. Progressively, though the work is expanding, employment in meat inspection is falling off. This is largely due to the inadequacy of present salaries, for even with overtime pay they are lower than those offered in industry, and in other government agencies for equal or similar work. Unless reclassifications are possible, there is danger of a complete breakdown of this essential service.

Furthermore, it appears certain that quotas, or some similar control device, will be necessary immediately following the present peak slaughter season when the supply of meat will again be substantially less than the demands of our Armed Forces, our Allies, and our civilian population. This may mean that some plants which have withdrawn from federal inspection, and many others which will wish to qualify for Government contracts, will request federal inspection. Such inspection must be extended, and will require the recruitment of additional veterinarians and meat inspectors.

Substandard classification: The Office of Personnel of the Department of Agriculture has made an exhaustive study of the classification problem and has indicated the grades to which employees performing each type of work should be assigned under the law. Veterinarians are now the lowest paid professional group in the Department. Ninety percent of all veterinarians are in grades P-1 (\$2,000-\$2,600) and P-2 (\$2,600-\$3,200), while only 6-1/2 percent are in P-3 (\$3,200-\$3,800) and only 3-1/2 percent are in grades above P-3. Sixty-one and one-half percent of the veterinarians employed under this appropriation are in the lowest professional grade, P-1, while other professional groups have only 21.2 percent in that grade. These comparisons are set forth in detail in the chart shown on the following page. Veterinarians make up 21.2 percent of the total number of professional persons employed in the Department; that is, over one-fifth of the total.

COMPARISON OF VETERINARIANS AND OTHER PROFESSIONAL GROUPS BY PERCENTAGE IN EACH GRADE



Other Professional Groups

Veterinarians

Key

In many instances these veterinarians are working in the same locality with other employees of the Department engaged in similar professional lines of work. Frequently they have equal educational background and the same number of years of service, but invariably the veterinarian will have advanced more slowly than his professional counterpart. As a consequence, morale among this group suffers seriously.

Opportunities for advancement in veterinary work in the Department are limited and are not attracting the better type college graduates. Many who enter the service immediately on graduation from college leave it after a short time to enter other fields in their profession. The problem of retaining them at the comparatively low salaries being paid or replacing those who leave has been a difficult one for many years, except in period of depression; but it is considerably aggravated by the present manpower situation.

Educational requirements and length of service: The educational requirements for the positions under consideration are graduation from an accredited college of veterinary medicine, which covers 5 years, including 1 year of pre-veterinary medical training. The grades held by these employees are not commensurate with the duties and responsibilities of the positions or the investment in time, energy, and money expended in obtaining a degree or acquiring the requisite experience. Many of the well qualified meat inspectors and lay assistants have been with the Department many years, performing increasingly valuable service and assuming additional responsibilities without reclassification to reflect these changes in duties. The lack of funds has made these reclassifications impossible.

Deferment: The problem of maintaining an adequate force of veterinarians has become so critical that the Department of Agriculture Committee on the Deferment of Government Employees has recognized the urgent need to request deferment of all veterinarians and key lay inspectors. Even though each case by law must be considered on its own merits, this fact is significant when it is considered that in the Department the only other entire class of positions for whom deferments may be requested, regardless of grade, consists of chemists in the regional laboratories and technically trained processed food inspectors. In spite of this action, the Department continues to lose more employees in this group than it can recruit.

Recruitment: Recruitment of personnel is practically impossible under present salary conditions. On May 24, 1943 the Civil Service Commission furnished a certificate of eligibles for the position of junior veterinarian which contained 53 names. Of these the Department communicated with 47 and failed to secure a single acceptance. It is also increasingly difficult to recruit lay inspectors because of the low level of salaries and inadequate promotional opportunities. They are lower than for comparable work in other Government activities, and men with farm experience, the main source for such employees in the past, are no longer attracted by the wages offered.

Previous attempts at solution, and history of problem: Basically, the situation that exists today is not new, although it has been aggravated by wartime conditions. In 1928 the problem became so critical that an increase of approximately \$200,000 was allowed by Congress in the appropriation act for the fiscal year 1929 to adjust the pay of nearly 1,300 veterinarians in the field within their then existing grades, thereby providing an average annual salary increase of about \$150 for each veterinarian. While this alleviated conditions somewhat, it was recognized even at that time that it would not accomplish a permanent cure. The combination of the Welch Act approved May 28, 1928, and the Brookhart Act approved July 3, 1930, which generally raised the minimum and maximum salaries in each grade by two steps, raised the salary of each veterinarian by \$140 to \$200. However, all Federal employees received the same benefits, and the differences between salaries paid the veterinary profession and other professions were not corrected.

In order to provide for some plan of advancement which would attract new personnel and aid in retaining those in the service, the Bureau of Animal Industry, which at that time employed the largest number of veterinarians, established a tentative plan for promoting veterinarians in groups. It was felt that most of the efficient employees could be held if promotions of \$100 each year were forthcoming until the average salary of grade P-2, \$2,900, was reached. The plan of promoting in groups was followed but, due to insufficient funds, the interval between promotions, especially as the higher salaries were reached, could not be held to one year.

Every effort has been made to meet the shortage of veterinarians without grade reallocations. In order to obtain new personnel, senior veterinary students have been contacted through the deans of the colleges, age limits have been raised for entrance to civil service examinations, and continuous unassembled examinations have been held since 1941. Some retired veterinarians have been reemployed. Occupational deferments are being requested for those veterinarians in the Department's employ who have been placed in Class 1-A.

For some years private practitioners have been appointed on a per diem basis for part-time employment on the Bang's disease eradication program in areas where the work was not sufficient to require the services of full-time veterinarians. These practitioners can now devote little, if any, time to such work.

A concerted effort has been made to spread the services of veterinarians in every way, by using nonprofessional employees wherever possible and by cutting supervision by veterinarians to a minimum. Inspections not requiring professional training have always been performed by lay inspectors or agents. The proportion of lay inspectors to veterinarians has been about 2 to 1, but now there are nearly 3 lay inspectors to every veterinarian on meat-inspection work.

The Department is confronted with shortages of lay inspectors and agents who assist the veterinarians. Farm experience and experience in handling livestock or in the preparation or processing of meats are required. In former years there has been a large supply of persons available for appointment to this work; register of eligibles established by the Civil Service Commission as a result of an examination for lay inspectors held in 1930 lasted nearly 10 years. However, a register of more than 8,000 names established from the 1941 examination was soon exhausted. In 1942 an open examination was announced by the Civil Service Commission and field stations engaged in meat inspection were asked to aid in a recruitment program, but it was possible to secure only a few applicants.

A tentative promotion plan was established, similar to that for veterinarians, providing for their promotion in groups at the rate of \$60 each year until a salary of \$2,000 was reached. However, as in the case of the veterinarians, limited funds prevented the annual promotions.

Plan of Work: The veterinarians are engaged in (1) Federal meat inspection with the basic functions of eliminating from the meat supply of the Nation all diseased, unsanitary, or otherwise unfit animals; (2) the control and eradication of animal diseases such as tuberculosis and Bang's disease, sheep and cattle scabies, hog cholera, dourine of horses, and the eradication of cattle fever ticks; (3) inspection of animals at public markets in the course of interstate transportation to prevent the spread of communicable diseases, and to assure that animals meet the health requirements of the States of destination; (4) inspection of imported animals, animal byproducts, hay, and straw to prevent the introduction into this country of foreign plagues; (5) inspections at commercial establishments producing anti-hog-cholera serum, hog-cholera virus, and other veterinary biologics to assure purity and potency of products; (6) inspection of poultry at market centers; and (7) research work to a limited extent on animal diseases.

The veterinarians, in addition to administering these programs, perform a wide variety of professional work in making inspections and tests in the field, packing houses, public stockyards, ports of entry into this country, commercial establishments preparing veterinary biologics, and in laboratories.

The work of the doctor of veterinary medicine in the Department is highly specialized and exacting. Each day the veterinarian on port-mortem inspection, for example, examines the viscera of hundreds of food animals for lesions revealing diseased conditions which render the meat unfit for human food. His work is routine only in the sense that he performs the same tasks daily just as the medical doctor makes his daily round of calls. Likewise, veterinarians employed on disease eradication and control perform professional duties which must never be allowed to become merely routine if the livestock industry of the country is to be protected adequately. Supervision of (a) the administering of preventive and curative serums and antitoxins and the use of dips, (b)

examining and testing the flocks and herds for disease, and eradicating the disease when found, all call for the exercise of independent judgment and discrimination, by educated, professional men.

The nonprofessional employees (lay inspectors, etc.) perform a variety of work, such as (a) supervising the cleaning and disinfecting of pens, premises, cars, trucks, and other vehicles which have contained animals effected with contagious, infectious, or communicable diseases; (b) assisting in examination of carcasses for signs of diseases or other abnormal conditions, and in the processing and handling of meat and meat food products during the period of curing, refining, and other preparation; (c) performing routine work in connection with the collection of bleedings, defibrination of blood and its clarification, and the heating, preservation, mixing, bottling, and sampling of anti-hog-cholera serum and hog-cholera virus; (d) assisting in tick eradication work which involved the inspection of cattle for ticks, collecting of specimens of ticks found on cattle, mixing and testing the dipping solution, and preparing reports; (e) examining animals at public markets for indications of infectious, contagious, or communicable diseases and parasites; (6) assisting in other lines of disease control in the field.

Reallocation of these employees to appropriate classification grades based on standards required by law, would require the following changes in grades:

FOOD DISTRIBUTION ADMINISTRATION

Summary of Proposed Reclassifications

	Number of <u>Employees</u>	Present Grade (Minimum Salary)	Proposed Grade (Minimum Salary)	Full year Changes in Basic Salaries
Professional service	235	P-1 (\$2,000)	P-2 (\$2,600)	\$75,400
	22	P-1	P-3 (3,200)	18,400
	6	P-2 (2,600)	P-1 (2,000)	-2,000
	165	P-2	P-3 (3,200)	33,300
	35	P-2	P-4 (3,800)	30,800
	13	P-3 (3,200)	P-4	4,300
	24	P-4 (3,800)	P-5 (4,600)	18,000
	<u>7</u>	P-5 (4,600)	P-6 (5,600)	<u>5,800</u>
Total, Prof. service	<u>507</u>			<u>184,000</u>
Subprofessional service	606	SP-4 (1,620)	CAF-4 (1,800)	99,780
	360	SP-4	CAF-5 (2,000)	113,880
	122	SP-4	CAF-6 (2,300)	69,560
	7	SP-4	CAF-7 (2,600)	6,320
	43	SP-5 (1,800)	CAF-4 (1,800)	-
	113	SP-5	CAF-5 (2,000)	12,880
	175	SP-5	CAF-6 (2,300)	66,800
	20	SP-5	CAF-7 (2,600)	13,840
	226	SP-6 (2,000)	CAF-5 (2,000)	-2,760
	476	SP-6	CAF-6 (2,300)	25,300
	92	SP-6	CAF-7 (2,600)	31,000
	2	SP-6	CAF-9 (3,200)	1,500
	7	SP-7 (2,300)	CAF-7 (2,600)	900
	3	SP-7	CAF-8 (2,900)	1,300
	38	SP-8 (2,600)	CAF-7 (2,600)	-
	9	SP-8	CAF-8 (2,900)	2,200
	<u>1</u>	SP-8	CAF-9 (3,200)	<u>200</u>
Total, Subprof. service	<u>2,300</u>			<u>442,700</u>
GRAND TOTALS	<u>2,807</u>			<u>\$626,700</u>

AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ANIMAL INDUSTRY

Summary of Proposed Reclassifications

	<u>Number of Employees</u>	<u>Present Grade (Minimum Salary)</u>	<u>Proposed Grade (Minimum Salary)</u>	<u>Full year Changes in Basic Salaries</u>
Professional service	320	P-1 (\$2,000)	P-2 (\$2,600)	\$124,300
	14	P-1	P-3 (3,200)	12,400
	74	P-2 (2,600)	P-3	9,200
	14	P-2	P-4 (3,800)	11,400
	32	P-3 (3,200)	P-4	13,500
	<u>16</u>	P-4 (3,800)	P-5 (4,600)	<u>12,200</u>
Total, Prof. service	<u>470</u>			<u>183,000</u>
Subprofessional service	44	SP-3 (1,440)	CAF-4 (1,800)	15,840
	15	SP-4 (1,620)	CAF-6 (2,300)	10,200
	11	SP-4	CAF-5 (2,000)	3,700
	3	SP-5 (1,800)	CAF-6 (2,300)	1,380
	9	SP-5	CAF-5 (2,000)	1,200
	85	SP-6 (2,000)	CAF-6 (2,300)	1,800
	<u>5</u>	SP-7 (2,300)	CAF-7 (2,600)	<u>700</u>
Total, Subprof. service	<u>172</u>			<u>34,820</u>
GRAND TOTALS	<u>642</u>			<u>\$217,820</u>

FOOD DISTRIBUTION ADMINISTRATION

Length of Service in Present Grade of Veterinarians and Lay Assistants to be Promoted

Present Grade	Number of em- ployees	Years of Service in Present Grade											Over 40
		0 to 3	3 to 5	5 to 10	10 to 15	15 to 20	20 to 30	30 to 40					
Professional Ser- vice:													
Grade 1.....	257	87	33	86	46	3	1	1					--
Grade 2.....	206	30	35	10	45	52	27	5					2
Grade 3.....	13	2	2	2	1	1	2	2					1
Grade 4.....	24	13	--	2	1	--	4	3					1
Grade 5.....	7	5	1	1	--	--	--	--					--
TOTAL.....	507	137	71	101	93	56	34	11					4
Subprofessional Service:													
Grade 4.....	1,095	926	68	95	5	1	--	--					--
Grade 5.....	351	89	154	46	48	12	2	--					--
Grade 6.....	796	109	80	65	140	200	128	72					2
Grade 7.....	10	5	1	2	1	--	--	--					--
Grade 8.....	48	46	1	1	--	--	--	--					--
TOTAL.....	2,300	1,175	304	209	194	214	130	72					2

AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ANIMAL INDUSTRY

Length of Service in Present Grade
of Veterinarians and Lay Assistants to be Promoted

Present Grade	Number of em- ployees	Years of Service in Present Grade											Over 40	
		0 to 3	3 to 5	5 to 10	10 to 15	15 to 20	20 to 30	30 to 40						
Professional ser-														
vice:														
Grade 1.....	334	63	49	213	9	--	--	--	--	--	--	--	--	--
Grade 2.....	88	6	2	9	10	61	--	--	--	--	--	--	--	--
Grade 3.....	32	20	2	2	6	2	--	--	--	--	--	--	--	--
Grade 4.....	16	15	1	--	--	--	--	--	--	--	--	--	--	--
Total.....	470	104	54	224	25	63	--	--	--	--	--	--	--	--
Subprofessional														
service:														
Grade 3.....	44	44	--	--	--	--	--	--	--	--	--	--	--	--
Grade 4.....	26	24	2	--	--	--	--	--	--	--	--	--	--	--
Grade 5.....	12	7	5	--	--	--	--	--	--	--	--	--	--	--
Grade 6.....	85	2	7	2	8	66	--	--	--	--	--	--	--	--
Grade 7.....	5	2	1	--	2	--	--	--	--	--	--	--	--	--
Total.....	172	79	15	2	10	66	--	--	--	--	--	--	--	--

FOOD DISTRIBUTION ADMINISTRATION

Number of Years the Employees to be Promoted
have been Engaged in Veterinary and Related Work in the Department

Present Grade	Number of em- ployees	Years of Veterinary and Related Service in the Department									
		0 to 3	3 to 5	5 to 10	10 to 15	15 to 20	20 to 30	30 to 40	Over 40		
Professional Ser- vice:											
Grade 1.....	257	80	43	78	42	5	7	2	--		
Grade 2.....	206	20	16	17	24	28	92	8	1		
Grade 3.....	13	--	--	--	1	2	4	5	1		
Grade 4.....	24	--	--	2	5	4	6	5	2		
Grade 5.....	7	--	--	--	--	2	3	2	--		
Grade 6.....	--	--	--	--	--	--	--	--	--		
TOTAL.....	507	100	59	97	72	41	112	22	4		
Subprofessional Service:											
Grade 4.....	1,095	934	62	92	4	2	1	--	--		
Grade 5.....	351	27	21	126	160	13	4	--	--		
Grade 6.....	796	35	1	8	58	134	416	141	3		
Grade 7.....	10	1	--	--	2	1	3	3	--		
Grade 8.....	48	3	--	9	8	5	18	5	--		
TOTAL.....	2,300	1,000	84	235	232	155	442	149	3		

AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ANIMAL INDUSTRY

Number of Years the Employees to Be Promoted Have Been
Engaged in Veterinary and Related Work in the Department

Present (grade	Number of em- ployees	Years of Veterinary and Related Service in the Department									
		0 to 3	3 to 5	5 to 10	10 to 15	15 to 20	20 to 30	30 to 40	Over 40		
Professional ser-											
vice:											
Grade 1.....	334	63	49	213	9	--	--	--	--		
Grade 2.....	88	--	--	4	7	13	47	15	2		
Grade 3.....	32	--	--	1	--	3	20	7	1		
Grade 4.....	16	--	--	--	1	1	11	2	1		
Total.....	470	63	49	218	17	17	78	24	4		
Subprofessional											
service:											
Grade 3.....	44	19	5	20	--	--	--	--	--		
Grade 4.....	26	13	3	6	1	--	3	--	--		
Grade 5.....	12	1	--	5	5	--	1	--	--		
Grade 6.....	85	--	--	1	2	13	42	26	1		
Grade 7.....	5	--	--	--	2	1	--	1	1		
Total.....	172	33	8	32	10	14	46	27	2		

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed.....	*\$2,976:	\$75,000:	\$77,307
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945).....	:	:	:
	894,000:	1,482,987:	1,598,345
Total cost of overtime (7 months in 1943).....	896,976:	1,557,987:	1,675,652

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: The principal purposes of the work are: (a) to insure through personal inspection that meat or meat products flowing in interstate or foreign commerce, or destined for use by such Federal agencies as the Navy Department, Lend-Lease Administration, and the Veterans Administration, are sound, wholesome, and otherwise fit for human consumption; (b) to provide Federal meat inspection during the present war emergency in respect of meat packing establishments engaged in intrastate commerce only, to facilitate the purchase of meat and meat food products by Federal agencies; (c) to insure sanitary preparation and handling of foods composed, entirely or in part, of meat; (d) to require the application of marks of inspection to inspected meat products; (e) to prevent false and deceptive labeling; and (f) to assure proper post-mortem diagnosis and disposition of carcasses in unusual cases through laboratory procedures; to conduct research on methods of treatment of carcasses and tissues to meet requirements of meat inspection regulations; and to conduct research on abnormal conditions in meat or its products through investigations of suspected feeding, management, or packing procedures or of diseases or parasites to which the conditions might be attributed.

The Problem and its Significance: In connection with Meat Inspection

Operations: Shortages of meat supplies at a time when civilian and military requirements are greater than ever before make it imperative to conserve every pound of meat produced and insure that it is so handled and processed as to be available for human consumption. Unsatisfactory and improper processing methods which give rise to waste might be tolerated during peacetime, but in war they are no less destructive to our food resources than sabotage itself.

For efficient results, each animal must be inspected before slaughter, and each carcass, including organs and parts thereof, must be carefully examined at the time of slaughter. Approximately 7.57 percent of all animals slaughtered are affected with some degree of abnormalcy, which is seldom obvious except on close scrutiny. Accordingly, the constant presence of inspectors and their careful examination in every detail are required during slaughtering operations.

Under normal conditions work load is fairly constant as to volume and cost. However, on June 10, 1942, the Congress, in H. J. Res. 315, directed the Department to "provide Federal Meat Inspection during the present war emergency in respect of meat packing establishments engaged in intrastate commerce only, in order to facilitate the purchase of meat and meat food products by Federal agencies, and for other purposes". As a result of the directive, the number of establishments operating under Federal inspection increased from 679 in 1942 to 842 in 1943, an increase of 25 percent.

This almost over-night increase in the number of small and scattered establishments where inspection services must be made available has substantially increased unit costs. In the fiscal year 1942, the cost per head for slaughtered animals inspected was 6.79 cents. In 1943 the cost was 7.15 cents (exclusive of overtime pay). This increase stems from four factors: (a) The necessity of detailing inspectors to plants engaged for brief periods in preparing meat and meat food products for sale to the Federal Government; (b) increased travel to isolated points; (c) reduced productivity in small processing plants; (d) the making of one or more preliminary inspections in plants which later abandon the idea of operating under the Federal Inspection Service. During the past year, more than 500 plants were inspected one or more times without finally adopting the service.

Since meat and meat products are highly perishable, re-inspections requiring the regular presence and personal observation of inspectors are necessary throughout all stages of processing, preparing, and packing. Any ingredients, such as spices and other seasoning added during the processing, must be carefully scrutinized for wholesomeness and proper use. Condemned meat or condemned meat products must be destroyed under strict supervision. The finished product, in addition, must be truthfully and informatively labeled. Investigations of cargoes carried interstate or shipped out of the country are necessary from time to time to see that only products of appropriate eligibility are handled.

Under the Import Meat Act and the Meat Inspection Acts, the Secretary of Agriculture may determine that meat and meat products may be offered for import by countries having a national system of inspection which is the substantial equivalent of the system maintained in the United States. However, each consignment is carefully inspected to see that only meat and meat products which have been properly certified from abroad are accepted and that they are sound, wholesome, and otherwise fit for food and truthfully labeled.

In connection with related research. In order to prevent the distribution of any unwholesome meat or meat products to the general public or to our armed forces and allies, and in order to assist in the conservation of our meat supply, it is imperative that proper diagnosis be made of diseased or other questionable conditions encountered in food-producing animals at the time of slaughter. This requires scientific personnel and efficient laboratory facilities to investigate unusual biochemical, pathological, and zoological questions which inevitably arise. It has not been necessary to establish special laboratories for this purpose inasmuch as highly specialized facilities have been available for many years in the Bureau of Animal Industry, which may be utilized with a minimum of cost and a maximum of efficiency.

General Plan: The principal meat inspection operations at meat packing establishments include ante-mortem and post-mortem inspections of cattle, sheep, swine, goats, and, to a limited degree, of horses; reinspection of meat and meat products during processing, preparation, and packing; and the supervision of marking and branding of products to insure truthful labeling. In addition, the service includes inspection under the Import Meat Act and Meat Inspection Acts of imported meat and meat food products and laboratory examinations as assurance against adulterations or similarly objectionable conditions.

When employees engaged in Federal meat inspection duties encounter an unusual disease, parasitic infestation or other abnormal condition, or when common diseases or parasitic conditions are found in unusual or extraordinary numbers or relationships, specimens are obtained and forwarded to the appropriate laboratory for diagnosis, research, or such other action as may be deemed proper.

Examples of Progress and Current Program: Meat Inspection operations at packing plants: The number of establishments and cities and towns where Federal meat inspection has been conducted during the past few years is as follows:

<u>Fiscal Year</u>	<u>Establishments</u>	<u>Cities & Towns</u>
1940	681	253
1941	668	257
1942	679	264
1943	842	336

The following tabulations show the extent of the increase in the various lines of work conducted under the Federal meat inspection service:

Animals Inspected Ante-mortem and Post-mortem

<u>Fiscal Year</u>	<u>Cattle</u>	<u>Calves</u>	<u>Sheep & Lambs</u>	<u>Goats</u>	<u>Swine</u>	<u>Horses</u>
1940	9,560,329	5,223,172	17,262,684	3,061	46,693,925	28,178
1941	10,126,861	5,393,566	17,811,612	5,452	48,710,059	14,641
1942	11,761,746	5,544,745	18,547,305	9,498	50,133,871	30,787
1943	11,572,285	5,089,331	21,804,016	30,891	56,867,080	39,935

Total

Total

1940 78,751,349
1941 82,062,191

1942 86,027,952
1943 95,403,538 *

* The dressed weight of all carcasses passed during the year was more than 18 billion pounds.

Number of Establishments under Federal Meat Inspection
with volume of livestock slaughtered and meat food products processed under
supervision by months for the fiscal years 1943, and estimated for 1944

Fiscal Year	No. of: Estab- lish- ments	Number of: Livestock Inspected	Meat Food Products Processed under Supervision (Lbs.)	Inspection of Imported Meat Food Products (pounds)
1943				
July	661	7,102,816	1,160,616,192	6,662,778
August	677	6,630,323	980,195,482	9,456,885
September	687	7,740,708	1,015,833,002	9,032,647
October	708	8,426,294	1,054,908,310	6,422,342
November	731	8,678,898	1,123,919,986	8,645,573
December	773	10,422,260	1,456,476,642	8,536,937
January	793	8,427,386	1,305,351,648	6,515,336
February	811	7,022,838	1,131,486,805	6,553,406
March	823	7,493,834	1,252,941,151	3,639,313
April	834	7,087,148	1,170,934,539	7,303,400
May	832	8,086,775	1,281,085,359	20,593,021
June	842	8,284,258	1,358,967,109	20,137,306
Total	-	95,403,538	14,292,716,225	113,498,944
1944				
July	844	8,600,823	1,375,879,510	15,937,879
August	843	8,162,018	1,286,517,017	7,913,979
September	843	8,313,487	1,130,953,423	12,136,647
October	845	8,736,672	1,260,104,050	11,210,227
November	850	9,000,000	1,400,000,000	11,500,000
December	860	9,000,000	1,450,000,000	11,500,000
January	880	10,000,000	1,600,000,000	12,000,000
February	900	10,500,000	1,800,000,000	12,500,000
March	930	10,000,000	1,700,000,000	11,000,000
April	950	9,500,000	1,500,000,000	10,500,000
May	980	9,000,000	1,400,000,000	10,000,000
June	1,008	8,500,000	1,200,000,000	10,000,000
Total	-	109,313,000	17,103,454,000	136,198,732

Ante mortem and post mortem inspections of animals during the fiscal year 1943

Kind of Animal	Ante Mortem inspection			Post Mortem inspection		
	Passed	Suspected 1/	Condemned	Total	Passed	Condemned: Total
Cattle	11,475,907	97,123	4,844	11,577,874	11,511,624	60,661 : 11,572,285
Calves	5,081,344	8,041	3,939	5,093,324	5,069,824	19,507 : 5,089,331
Sheep and Lambs	21,792,185	12,078	12,996	21,817,259	21,695,545	108,471 : 21,804,016
Goats	30,747	144	69	30,960	30,608	283 : 30,891
Swine	56,736,514	131,466	21,579	56,889,559	56,736,007	131,073 : 56,867,080
Horses 2//	59,807	129	84	40,020	39,152	783 : 39,935
Total	95,156,504	248,981	43,511	95,448,996	95,082,760	320,778 : 95,403,538

- 1/ "Suspected" is used to designate animals which may be condemned in whole or part on special post mortem inspection.
- 2/ Horses are slaughtered and their meat handled and prepared in establishments separate from those in which cattle, calves, sheep, goats, and swine are slaughtered.
- 3/ Includes 1,895 previously suspected animals which died in pens.

Meat and Meat Food Products Prepared and processed under Supervision 1/

Fiscal Year	Pounds
1940	9,690,165,254
1941	10,514,837,866
1942	12,039,492,563
1943	14,292,716,225

1/ Figures represent "inspection pounds". Some products may be inspected and recorded more than once if they are processed more than once.

Product	Quantity (Pounds)
Placed in cure:	
Beef	124,590,795
Pork	3,354,027,875
Smoked and/or dried:	
Beef	48,222,091
Pork	2,019,246,816
Sausage:	
Fresh, finished	309,945,869
Smoked and/or cooked	928,154,196
To be dried or semidried	131,048,932
Loaf, headcheese, chili con carne, jellied products, etc.	225,502,714
Cooked meat:	
Beef	17,971,968
Pork	284,498,807
Canned meat and meat food products:	
Beef	150,275,165
Pork	1,177,275,699
Sausage	314,683,723
Soup	217,521,385
All other	599,700,312
Bacon, sliced	393,219,287
Lard:	
Rendered	1,607,659,145
Refined	1,376,701,158
Rendered pork fat:	
Rendered	193,801,803
Refined	114,215,182
Oleo stock	146,176,965
Edible tallow	110,735,574
Compound containing animal fat	352,303,865
Oleomargarine containing animal fat ...	60,057,659
Miscellaneous	28,576,409
Horse meat:	
Chopped	6,602,831
	<u>2/</u>
Total	14,292,716,225

1/ The following quantities of meat and meat food products were condemned on reinspection and destroyed for food purposes on account of having become sour, tainted, rancid, unclean, or otherwise unfit for human food: Beef, 3,200,189 pounds; pork, 8,153,021 pounds; mutton, 127,783 pounds, veal, 48,395 pounds; goat meat, 102 pounds; horse meat, 91,965 pounds; total, 11,621,455 pounds.

2/ This figure represents "inspection" pounds as some of the products may have been inspected and recorded more than once due to having been subjected to more than 1 processing treatment, such as curing first and then canning.

Inspection for Other Government Agencies

<u>Fiscal Year</u>	<u>Pounds</u>
1940	145,235,616
1941	425,565,970
1942	391,947,092
1943	763,306,009

1/ Inspections for other Government agencies are performed on a reimbursable basis.

Meat and meat food products inspected for condition and conformance
to specifications for other Government agencies, fiscal year 1943

<u>Branch of Government</u>	<u>Passed (Pounds)</u>	<u>Rejected (Pounds)</u>
Navy Department	661,595,122	10,035,479
Marine Corps	73,597,885	87,329
Federal Surplus Commodities Corporation	13,778,853	-
Coast Guard	5,982,547	134,481
War Shipping Administration :	3,581,673	32,456
Veterans' Administration:		
Supply Service	1,567,791	22,342
Department of Justice:		
Bureau of Prisons	1,200,220	34,043
Department of Interior:		
Alaska Railroad	485,023	3,024
Office of Indian Affairs ..:	368,691	3,048
Alaska Road Commission ...:	6,885	-
Fish and Wildlife Service..:	2,729	1,200
Tennessee Valley Authority ..:	441,431	1,872
War Department:		
Army Engineers	355,183	1,852
Maritime Commission	199,663	8,237
Department of Commerce:		
Inland Waterways Corpora- tion	62,975	92
Department of Agriculture:		
Forest Service	42,392	160
Federal Security Agency:		
Public Health Service ,....:	36,946	1,531
Total	763,306,009	10,367,146

Laboratory Analyses of Meat and Meat Products for Adulterations
and other Objectionable Conditions 1/

<u>Fiscal Year</u>	<u>Number of Samples Analyzed</u>
1940	33,894
1941	28,972
1942	30,310
1943	29,609

- 1/ The seven meat inspection laboratories maintained in New York, Washington, Chicago, St. Louis, Omaha, San Francisco and Kansas City make chemical analyses and other scientific examinations of meat, meat food products and ingredients used in their preparation. During 1943 adverse reports were made on 4,505 samples for failure to conform with inspection requirements.

Inspection of Imported Meat and Meat Food Products

<u>Fiscal Year</u>	<u>Pounds</u>
1940	116,436,622
1941	106,954,816
1942	190,416,650
1943	Recorded but not published (this information will be supplied upon request)

Labeling

Approval was given to 17,064 labels for use by domestic processors, and 134 for use on foreign meat and meat food products intended for importation. There were returned without approval 2,108 labels and sketches of proposed labels.

Construction

During 1943, 694 sets of drawings and sketches for construction and remodeling of processing plants and for major equipment installations were submitted for approval. These were examined primarily to insure (1) that the proposed construction facilitated sanitary maintenance, (2) that equipment was of suitable type and so arranged that operations could be conducted in a clean and otherwise acceptable manner, and (3) that the facilities provided were suitable for efficient inspection.

(i) Virus Serum Toxin Act

Appropriation Act, 1944	\$223,148
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+41,667
Total anticipated available, 1944	264,815
Budget estimate, 1945	279,228
Increase	<u>+14,413</u>

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. Control of manufac- ture, importation and shipment of viruses, serums, toxins, etc.	\$244,384:	\$264,815:	\$279,228:	+\$14,413(1)
Covered into Treasury in: accordance with Public: Law No. 674	570:	--:	--:	--
Unobligated balance ...	584:	--:	--:	--
Total available	245,538:	264,815:	279,228:	+14,413
Transfer from "Salaries and expenses, animal industry, Agricultural: Research Administra- tion," eradicating tuberculosis and Bang's disease	-15,620:	--:	--:	--
Anticipated deficiency for overtime pay	--:	-41,667:	--:	--
Total estimate or appropriation ...	229,918:	223,148:	279,228:	

INCREASES OR DECREASES

- (1) An increase of \$14,413 under this item for 1945 is composed of:
- (a) An increase of \$7,113 (including \$1,053 for overtime pay) to meet increased personnel costs due to proposed reclassifications as described in detail under the item "Meat inspection."
 - (b) An increase of \$7,300 (including \$1,300 for overtime pay) for additional personnel to supervise the work in licenses establishments where production of veterinary biologics has increased over 20 percent during the past year and is expected to continue at that level.

Objective: To provide a sufficient number of inspectors to supervise essential operations at commercial establishments licensed under the Virus Serum-Toxin Act of March 4, 1913.

The Problem and its Significance: Owing to increased production, the personnel available has not been sufficient to furnish the minimum supervision believed necessary to assure that animal biologics which are produced and marketed are not worthless, contaminated, dangerous or harmful. If animal biologics which are worthless are allowed to be sold it produces an unnecessary drain on the income of livestock producers. If contaminated, dangerous, or harmful products are allowed to enter commercial channels and are used on animals there is established a serious threat to the livestock industry. In order that we may know that licensed establishments are observing our requirements a certain minimum of supervision is necessary. During the past year repeated reports have been received from inspectors in charge in the field that the personnel assigned to their stations has not been sufficient and that certain operations were carried on without supervision.

Plan of Work: The assignment of one additional junior veterinarian at each of three field stations--Sioux City, Iowa; St. Joseph, Missouri; and Kansas City, Kansas-- is proposed.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	*\$17,157	\$1,432	\$1,432
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	6,200	41,667	44,020
Total cost of overtime (7 months in 1943)	23,357	43,099	45,452

*Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To insure that all veterinary biologics produced by licensees are, in fact, not worthless, contaminated, dangerous, or harmful, and to prevent, insofar as possible, the interstate movement or importation of any veterinary biologic product, organism, or vector that is worthless, contaminated, dangerous, or harmful.

The Problem and its Significance: Biological products that are not properly prepared and tested may be worthless, contaminated, dangerous, or harmful to animals treated therewith. They may either fail to prevent or control an outbreak of disease and may even be the means of spreading disease. A license issued by the Secretary should carry with it reasonable assurance to the livestock producer that the products when properly used will afford protection and not be harmful to his animals. A biologic that is contaminated or otherwise improperly prepared, not only may endanger the herd that is treated, but may prove disastrous to other herds in the community through failure of the product in some respect.

General Plan: This work entails the detailing of sufficient inspectors to the establishments producing anti-hog-cholera serum and hog-cholera virus so that all operations connected with the production and testing of these products are carried out under direct supervision. Inspection of plants producing biological products other than anti-hog-cholera serum and hog-cholera virus is made periodically or upon instructions for special reasons.

Examples of Progress and Current Program: The increase in estimated production for 1944 and 1945, as reflected in the following table, is occasioned by anticipated increased demands to safeguard the livestock population during the war emergency. Experience has demonstrated that any increase in value of and demand for livestock or their products also increases the demand for biologics for use in combating animal diseases. Licensees are enlarging their production facilities whenever practicable.

	: Actual, R. Y. 1943	: Estimated, F.Y. 1944 and F.Y. 1945 (each year)
(a) Establishments producing anti-hog-cholera serum and hog-cholera virus ..	: 40	: 40
Production:	:	:
Serum (cc)	: 1,734,288,750	: 1,320,003,135
Virus (cc):	:	:
Simultaneous	: 120,342,128	: 121,545,520
Hyperimmunizing	: 359,305,097	: 360,595,850
Inoculating	: 1,728,718	: 600,275
Animal inspections	: 5,052,993	: 5,652,180
Tests supervised	: 20,305	: 22,335
(b) Establishments producing other biologics	: 40	: 41
Production:	:	:
Cc	: 418,479,615	: 422,664,421
Units	: 793,161,500	: 840,730,600
Milligrams	: 32,551,220	: 35,806,340
Disks	: 1,079,127	: 1,295,600
(c) Products destroyed (all kinds):	:	:
Cc	: 46,923,982	: 57,690,200
Units	: 3,205,251	: 3,350,300
Milligrams	: 2,476,980	: 2,587,900
Disks	: 75,343	: 76,000
(d) Export certificates issued	: 500	: 840

(j) Marketing Agreements,
Hog Cholera Virus and Serum

Appropriation Act, 1944	\$30,689 (a)
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	6,318
Total anticipated available, 1944	37,007
Budget estimate, 1945	38,444 (a)
Increase	+1,437

(a) Transferred from the unobligated balance of the appropriation provided by section 12(a), Title I, of the Agricultural Adjustment Act of May 12, 1933.

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Marketing agreements, hog cholera virus and serum ...	\$30,679	\$37,007	\$38,444	+ \$1,437 (1)
Covered into Treasury in accordance with Public Law 674	19	- -	- -	- -
Unobligated balance	10	- -	- -	- -
Total available	30,708	37,007	38,444	+ 1,437
Anticipated deficiency for overtime pay	- -	- 6,318	- -	
Total estimate or transfer	30,708	30,689	38,444	

INCREASES OR DECREASES

(1) An increase of \$1,437 (including \$257 for overtime pay) under the project "Marketing agreements, hog cholera virus and serum" to meet increased personnel costs due to proposed reclassifications as described in detail under the item "Meat Inspection."

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$3,002	- -	- -
Additional funds for overtime (appro- priated, 1943; estimated supplemental, 1944; and included in budget estimate, 1945)	- -	\$6,318	\$6,575
Total cost of overtime (7 months in 1943)	3,002	6,318	6,575

WORK UNDER THIS APPROPRIATION

Objective: To insure that the control agency and handlers of anti-hog-cholera virus observe the provisions of the marketing agreements and order.

The Problem and its Significance: The Serum and Virus Law of August 24, 1935, and Marketing Agreement of December 7, 1936, stress the economic importance of producers and other handlers maintaining an adequate supply of serum and virus at all times, and aim to prevent undue and excessive fluctuations of prices, unfair methods of competition, and unfair trade practices.

General Plan: The marketing agreement is enforced by a control agency selected by the Secretary and handlers, whose acts are subject to review by the Secretary and his representatives. The work relates mainly to reviewing acts of the control agency, attendance at meetings, and the assembling of economic data relating to the production, sales, and prices of anti-hog-cholera serum and hog-cholera virus. Proposed amendments to the agreement and order have entailed conferences and public hearing for the purpose of receiving testimony and affording all interested parties the opportunity to file briefs.

Examples of Progress and Current Program: At the close of the fiscal year 1943, there were 242 handlers of anti-hog-cholera serum and virus operating under the marketing agreement, an increase of 30 over the previous fiscal year.

Chemical, pathological, and zoological investigations relating to meat inspection. A large variety of specimens were received from the Meat Inspection Division of the Food Distribution Administration. Diagnoses were made and information relative to the nature of the conditions encountered was given. Opinions were also given to various governmental agencies regarding the wholesomeness of shipments of frozen, dressed poultry.

During the past fiscal year an extensive study has been made of the nutritive properties of the protein in both commercial and experimental lots of dehydrated beef, pork and mutton as a part of the general investigation of meat dehydration conducted by the Agricultural Research Administration. The results indicate that the protein in properly prepared dehydrated meat is highly digestible and of high biological value.

Experiments were made to determine whether trichinae survived in smoked pork products that are not prepared in special ways, with the objective of destroying these parasites. It was found that hams, shoulders, and bacon from trichina infected hogs, smoked so as to produce an internal temperature of at least 120 degrees for several hours, were entirely free from live trichinae. Evidently the continued action, for several hours, of internal temperatures of 120 degrees or higher was sufficient to destroy these parasites and render the products safe for human consumption.

(k) Eradication of Foot-and-Mouth
and Other Contagious Diseases of Animals

This item continues the availability of \$305,000 of the unexpended balance of the appropriation of \$3,500,000 made in 1924 to be used in case of an emergency arising from an outbreak of foot-and-mouth or other contagious diseases of animals. It provides also that \$5,000 of this balance may, if needed, be used for the control of European fowl pest and similar diseases in poultry. No expenditures are contemplated during the fiscal year 1944 unless an emergency arises, but it is essential that funds be available at all times to insure immediate protection of the American livestock industry should outbreaks occur. This is particularly important under present world conditions when most countries are at war. In many of them there has been a complete breakdown of livestock sanitary requirements.

(1) Special Research Fund, Department of Agriculture
(Allotment to Bureau of Animal Industry)

This budget schedule covers obligations under an allotment for special research projects and four regional research laboratories located as follows: Auburn, Alabama, for study of the mechanism of infection in the contagious, infectious and parasitic diseases of livestock and poultry; Dubois, Idaho, for the improvement of sheep for Western ranges through the application of breeding methods; Ames, Iowa, for the improvement of swine through the application of breeding methods; and East Lansing, Michigan, for the improvement of viability in poultry.

(m) Working Funds (Bureau of Animal Industry)

This budget schedule covers obligations under advances, pursuant to Section 601 of the Economy Act of June 30, 1932, for services performed for various agencies as indicated in the attached statement of obligations under supplemental funds.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS a/

Item	: Obligations, 1943	: Estimated obligations, 1944	: Estimated obligations, 1945
Special Research Fund, Department of Agriculture:			
Special research projects	\$36,044	\$40,960	\$60,640
Special research laboratories in major agricultural regions	271,714	303,834	303,834
Total, Special Research Fund ..	307,758	344,794	364,474
Working Fund, Bureau of Animal Industry, Agriculture: (Advance from Office of Scientific Research and Development):			
Investigations of the reduction in bulk and weight of the ration for army horses	6,938	6,750	- -
(Advance from War Department): Research to develop the best material available to date for sleeping bag fillers with particular reference to treated chicken and turkey feathers .	- -	13,800	- -
Total, Working Funds	6,938	20,550	- -
Total, Obligations under Supplemental Funds	314,696	365,344	364,474

a/ Exclusive of Lend-lease funds, which are not carried in the regular Budget.

PASSENGER-CARRYING VEHICLES

The amount included for the fiscal year 1945 (\$108,150) will permit the Bureau to replace 105 old vehicles at an average cost of \$1030, including freight when exchange allowances are taken into account. This is about 16 percent of the Bureau's cars. Of the 668 Bureau passenger-carrying vehicles now in operation, nearly 95 percent are used in inspectional work on farms in rural districts, and many of them have mileage of 18,000 and upward a year. It has been the Bureau's experience that cars assigned to rural inspectional work receive such rough use on secondary and country roads and lanes leading to farms that they normally would be replaced about every three years, in order to keep mileage charges at the lowest possible point and to prevent frequent interruptions to the work which occur due to breakdowns when badly worn equipment is kept in service. However, under present conditions it is realized that it is imperative to use cars as long as possible, even though an earlier

replacement would be more economical. Every means possible is being used to extend the life of all cars. All the cars to be replaced have reached the point where they can no longer be kept in service, the average mileage being approximately 76,000 and in individual cases running as high as 100,000.

The Bureau is unable to carry on economically and efficiently its varied activities in the field by the use of public transportation. Therefore, when government-owned cars are not available, it is necessary to authorize employees to operate their privately-owned cars on a mileage basis. The Bureau has found that in normal times the use of government-owned passenger-carrying vehicles for transporting its employees is considerably less expensive than when reimbursement is made to employees for the use of their own cars, and that they can be operated in almost every section of the country for slightly over three cents a mile. This estimate is based on purchase price and operation charges, less amounts received when old cars are disposed of. Even under present abnormal conditions our mileage costs are under costs for use of the privately-owned cars of employees.

AGRICULTURAL RESEARCH ADMINISTRATION

Bureau of Dairy Industry

(a) Salaries and Expenses

Appropriation Act, 1944	\$755,720
Anticipated deficiency for overtime pay required by the War	
Overtime Pay Act of 1943	+57,238
Total anticipated available, 1944	812,958
Budget estimate, 1945	812,958

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. General administration and business service	\$ 98,466:	\$114,830:	\$114,830:	--
2. Investigations of influences of breeding, feeding, and management practices on efficiency of production	287,460:	304,394:	304,394:	--
3. Investigations of the nutritional and other physiological factors affecting the usefulness of dairy cattle	91,290:	101,388:	101,388:	--
4. Investigations of dairy-herd-improvement association practices in relation to efficiency of production	125,839:	135,497:	135,497:	--
5. Investigations for the utilization of milk in the manufacture of milk products	139,689:	151,421:	151,421:	--
6. Administration and enforcement of the process (or renovated) butter act (regulatory)	4,942:	5,428:	5,428:	--
Covered into Treasury in accordance with Public Law 674	588:	--:	--:	--
Unobligated balance	8,243:	--:	--:	--
Total available	756,517:	812,958:	812,958:	--

PROJECT STATEMENT - Continued

Project	1943	1944 :(estimated):	1945 :(estimated):
Transferred to:			
"Salaries and expenses, Office of Administrator, Agricultural Research Administration"	+3,000:	- -:	- -
"Salaries and expenses, library"	+5,140:	- -:	- -
"Salaries and expenses, Office of Information"	+100:	:	
Anticipated deficiency for overtime pay	- -:	-57,238:	- -
Total estimate or appropriation.	764,757:	755,720:	812,958

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Salaries and expenses: For necessary expenses, including not to exceed: ~~[\$362,740]~~ \$410,345 for personal services in the District of Columbia, of the Bureau of Dairy Industry in carrying out the provisions of the Act of May 29, 1924 (7 U.S.C. 401-404), including investigations, experiments, and demonstrations in dairy industry, cooperative investigations of the dairy industry in the various States, [inspection of renovated butter factories] for carrying out the applicable provisions of the Acts of May 9, 1902 (26 U.S.C. 2325, 2326(c), 2327(b), and August 10, 1912 (26 U.S.C. 2327(c)) relating to process or renovated butter, and the Act of May 23, 1908 (21 U.S.C. 94 (a)) insofar as it relates to the exportation of process or renovated butter, repairs to buildings, and not to exceed \$5,000 for the construction of buildings ~~[\$755,720]~~ \$812,958.

The language deleted appears to confine the Bureau's responsibility under the cited act to factory inspections. The Bureau also inspects materials and ingredients used in process butter manufacture, and approves marks, brands and labels therefor. The new language is proposed so as to more fully define the authorities for and nature of the work actually being performed.

Statement of Overtime Costs

	1943	Est. 1944:	Est. 1945
Overtime absorbed	\$47,354:	\$41,012:	\$41,402
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	- -:	57,238:	57,238
Total cost of overtime (7 months in 1943) ...	47,354:	98,250:	98,640

WORK UNDER THIS APPROPRIATION

Objective: To increase the milk and butterfat producing efficiency of the Nation's dairy cows; to improve the quality of products made from milk; to effect greater efficiency in manufacturing methods; to develop new milk products and provide for the more efficient utilization of milk by-products; and to bring about greater sanitation in the production, transportation, processing, and distribution of market milk and cream.

The Problem and its Significance: There are about 26 million cows in the United States kept for milking purposes. The average butterfat production of the cows is only 188 pounds a year, which is too low for profit. Only one-third of these cows actually return a profit to their owners. Methods of selecting and breeding must be devised whereby 90 percent or more of the animals raised for dairy purposes will possess an inheritance for profitable production. This problem has particular significance at this time if the necessary quantities of milk are to be produced to supply military, civilian, and Lend-Lease needs.

The national dairy herd must be fed in a manner that will maintain the health of the animals and insure economical production of milk and butterfat, and at the same time result in the production of milk with a maximum of nutritive and health-giving properties. Research is required to determine the most economical methods of feeding for milk production under the various conditions of feed supplies and prices that may occur; and to determine the relation of the cow's diet to her health and reproductive functions and also to the nutritive properties of the milk produced.

Quality control in the manufacture of dairy products is possible only through a knowledge of the bacteriological and chemical changes involved and the application of this knowledge to factory processes. This requires research to provide the basis for formulas and rules applicable to factory conditions. Defects in quality are usually the result of insufficient knowledge of the factors influencing flavor or texture and of the methods controlling these factors under commercial conditions.

General Plan: The work is carried on through field and laboratory experiments in cooperation with state colleges, agricultural experiment stations, and extension services, other Government agencies, dairymen, and manufacturers of dairy products. Some phases of the work are conducted cooperatively in each State and in Hawaii and Puerto Rico. Breeding experiments are conducted to ascertain the comparative effects of different methods of breeding in fixing an inheritance for high and uniform levels of producing ability in dairy cows; to develop methods for judging at an early age the potential producing ability of heifers in order to avoid raising to maturity those heifer calves that should be discarded because of inferior milk-producing ability. Other phases of the production research are the effect of nutrients on growth, reproduction, health, and yield and composition of milk, and the effect of the application of breeding and feeding practices on the level and economy of production. Laboratory research which normally is devoted to studies of abstract problems

has been suspended for the duration of the emergency and the work directed to projects having a direct relationship to the war effort.

Examples of Progress and Current Programs: The following are examples of recent accomplishments under this appropriation.

Investigations of Influence of Breeding, Feeding, and Management Practices on Efficiency of Production

Breeding for higher milk-producing ability: Breeding experiments with cattle are necessarily slow, but the experiments in which meritoriously proved sires are used for generation after generation, in an effort to fix an inheritance for high levels of production, are making definite progress. This progress is measured by the relative producing ability of the cows by generations, the decreased frequency with which low-producing animals appear, and the transmitting ability for level of production of the bulls resulting from these matings. Bull calves from experimental herds are loaned to cooperating farmers for the purpose of obtaining a measure of their transmitting ability. The breeding experiments are proving a success in developing strains that possess a superior germ plasm for level of production and as a result cooperators have had the use of unusually good bulls.

The records of dairy-herd-improvement associations and data from other sources indicate that for every bull the average dairy farmer gets that improves the production of his herd, he also gets one that lowers the production. As a result he makes no progress in improving the hereditary ability of his cattle for better production. On the other hand, 85 percent of the bulls from the superior strains developed in the experimental herds have improved the production level in the herds in which they were used. On the average, each daughter has produced 38 pounds more butter-fat per year than her dam.

There are now some 300 bulls from experimental herds in farmer-owned and institutional herds. A cooperative relationship has been established under which sires bred in the experimental herds that possess a superior germ plasm for higher level of production are made available to artificial breeding circuits. Ways and means for the expansion of these artificial breeding circuits are being studied with the idea of putting into service a larger number of the bulls bred in the experimental herds and thus bring about a more rapid improvement in the producing ability of a greater number of farm-owned dairy cows.

While the dissemination of this superior germ plasm from the experimental herds is increasing the actual production of milk, perhaps its greatest value is in the demonstration it is offering farmers of the value of good breeding in improving livestock. With the prevailing scarcity of labor on dairy farms, it is more important than ever before that each cow unit be a profitable producer.

The progress in developing superior strains of dairy cattle at the Bureau's field experiment stations is indicated by the success of cooperating farmers who are using the station-bred bulls. Station-bred bulls that possess superior germ plasm will improve the production level of the farm herds in which they are used, if the herds are maintained under environmental conditions that will enable the animals to produce up to their hereditary capacity, and that these conditions remain uniform from year to year so that the production level of different generations of cows is comparable.

An analysis of the progress of the breeding work at the Huntley, Montana, station, for example, discloses that there were fifteen cooperating herds where three or more station-bred bulls had been used and where each of these bulls had three or more tested daughters. When the data from these fifteen herds are summarized, it is shown that there was a progressive increase in the level of production with each succeeding cross of station-bred bulls, from a best record average of 441 pounds of butterfat in the 265 "foundation cows" to a best record average of 559 pounds of butterfat in 26 great-great-granddaughters carrying four crosses of station-bred bulls.

Eighteen additional young bulls from the Beltsville experimental herds were placed in cooperating herds during the year to be proved. Of the 103 now in service, 44 are in artificial-breeding rings and bull associations. The others are in State institutional and privately owned cooperating herds. A summary of the results in these cooperating herds indicates that Beltsville-bred bulls have already sired daughters which, on the average, produced 38 pounds more butterfat per year than their dams.

As this phase of the breeding research progresses, the cooperators' herds may become small reservoirs of the Beltsville superior germ plasm, which eventually may be fed into other farm herds to further exert its power of improvement. The sale of young bulls by cooperators will introduce the germ plasm from the Beltsville experimental breeding herds into the herds where they are used.

Some cooperators have already used a number of Beltsville-bred bulls in succeeding generations, which increases the probability that the young bulls now born in their herds will have the kind of germ plasm that will make them successful sires.

Some herds in the artificial breeding circuits may also become reservoirs for the superior germ plasm developed at Beltsville. The widespread benefit to be derived from using good sires in artificial breeding circuits is shown by the report that a proved sire recently sent from Beltsville to the New York Artificial Breeders' Association will sire at least 500 calves during his first year of service.

The Bureau's experimental breeding herds will continue to accrue data that will indicate the system of breeding that will give uniformly good results. So far as is known, these are the only herds in existence where the animals

have been kept under uniform environmental conditions for a number of generations, where selection has not been practiced in the testing program, and where different systems of mating have been carried out under comparable conditions. Thus, these herds become more valuable year after year as a source of information for progressive livestock men.

Feeding for economical milk production: Experiments are being continued to determine methods for more economical and efficient feeding for milk production and for growing young stock; the more efficient management of pastures; determination of which feed crops are the most economical to produce, and of methods of curing roughages that will be most efficient in the preservation of their nutrients in the form that they can be best utilized by dairy cows. The results of these experiments are usually in such form that they can readily be used by dairy farmers. Insofar as possible, new projects undertaken will be those which are calculated to help solve the immediate problems of the dairyman.

For example, dairymen and dairy workers have insisted that grain rations for dairy cows should contain a number of different grains or grain by-products, including high-protein concentrates. These ideas are based on beliefs that such a mixture is more palatable than a single grain and that no essential nutrient (especially amino acids in the protein) is so likely to be lacking.

Experiments recently completed at three of the Bureau's field stations (Woodward, Oklahoma; Hannibal, Missouri; and Mandan, North Dakota) show that dairy cows will produce well and economically on a single-grain ration, such as corn, barley, or kafir, if they receive all the legume hay and silage they want. The results indicate that complicated grain mixtures, often containing six or eight different grains or grain by-products, are not necessary for good production.

The cows on the single grain averaged 12,347 pounds of milk and 505 pounds of butterfat and the cows on the grain mixture averaged 13,251 pounds of milk and 531 butterfat (mature basis). The single-grain group produced 93 percent as much milk and 95 percent as much butterfat as the mixed-grain group. At current local prices for feeds, the feed cost per pound of butterfat was 28 cents for the single-grain ration and 31 cents for the grain mixture at one station, 25 and 23 cents, respectively, at another station, and 27 cents for each ration at the third station. This information is of considerable practical importance at present, because of the shortage of many of the feeds ordinarily used in mixtures, especially high-protein concentrates.

The calf's udder as an index to future production: Results obtained during the year substantiate the findings that a positive relationship exists between the mammary development in the very young Holstein calf and subsequent producing ability, and the data also show much less difference between the Holsteins and Jerseys in this respect than was previously indicated.

Relationships between various parts of the calf's body have been determined to ascertain the extent to which, by examining the udder of the calf at various ages, the poorly attached, broken-down udder in the cow can be foreseen. In Holsteins, fairly significant relationships for evaluating the firmness with which the gland tissue of the fore udder is attached to the abdominal wall were found to exist between the calf at ages ranging from 4 to 12 months and the cow at different stages of the first lactation period. The analysis of the data for Jerseys is only partly completed but the degree of relationship is essentially the same as for Holsteins.

Mastitis prevention and control: Because of the grave effects of mastitis (a chronic infection of the udder) on the national production of milk and butterfat, the activities relating to various phases of the relationship of conformation to producing ability in dairy cows have been devoted to a study of this disease, its effect on production, and its eradication and prevention. The Bureau of Animal Industry estimates the annual loss due to mastitis at 19 million dollars. Other estimates put the annual monetary loss at over 70 million dollars. Some surveys show that 26 percent of all lactating cows were infected with streptococci, the most common of several causes of bovine mastitis. One experiment station estimated that mastitis infection reduces milk production in affected quarters by approximately 22 percent. These figures would seem to indicate that the total loss in milk production in the United States as a result of mastitis is in excess of 3 percent.

Studies conducted at the Beltsville Station showed that for a group of 170 cows, 56 (or 32.9 percent) had infected udders and that an average of two quarters of each udder was infected. Infected quarters have been treated by infusing them with a mineral oil suspension of sulfanilamide and sulfadiazine. During the year 108 separate quarters were treated, of which 94 (or 87 percent) were cleared of the causative organisms.

Investigations of the Nutritional and other Physiological Factors affecting the Usefulness of Dairy Cattle

Investigation of still-unidentified nutritional properties of milk: Research in the Bureau of Dairy Industry during the last few years has provided convincing evidence that milk contains some growth-promoting substance that has not yet been identified. Since, in planning nutritional programs, a shortage of milk in some form may sometimes make it necessary to rely more on other foods, it is important not only to know the nature of the unidentified substance in milk but also the extent to which it may exist in other foods.

In the preliminary research, laboratory animals were fed a basal ration supplemented with milk in some form for comparison with supplements of the various nutritive essentials that were then known to science. As new nutritive factors were discovered they were tested in turn, but in every comparison the animals made more normal growth and reached sexual development

earlier when milk was a part of the ration. This was evidence that milk supplied some nutritional factor which the scientists were unable to duplicate from their long list of known nutritive essentials.

The same growth-promoting effect of milk has now been obtained by supplementing the basal ration with either commercial casein, commercial casein extracted with ether, whole milk from barn-fed and pasture-fed cows, commercial dried skim milk, cheese (cottage, Cheddar, and Swiss), beef muscle, lettuce, or the extract of liver that is used in the treatment of pernicious anemia. The growth obtained with these supplements was from 75 to 100 percent faster than growth on the basal ration. The growth effect was apparent in the weights of the ovaries, uterus, adrenals, seminal vesicles, prostate gland, epididymis, thymus, and the organism in general.

Tests to determine other possible sources of the unidentified factor showed that hays (U.S. No. 1 alfalfa, U.S. No. 3 alfalfa, U.S. No. 1 timothy, and U.S. No. 3 timothy) contain some of the factor, since rats on these hays grew 25 to 50 percent faster than litter mates on a basal ration deficient in the factor. The growth factor occurs only in very small amounts, if at all, in soybean oil meal, linseed oil meal, wheat bran, and yellow corn. It is practically absent from white flour, enriched white flour, and whole wheat flour.

Prevention and control of sterility in dairy cattle: In the past few years many laboratories have demonstrated that sexual and reproductive functions are dependent on hormones elaborated by the pituitary gland, which is situated at the base of the brain. Certain types of sterility in farm animals are the result of deficiencies of the sex-stimulating (gonadotrophic) hormones of the pituitary.

Research is now under way to (a) study the effect of dietary factors on the elaboration of the gonadotrophic hormones and, therefore, upon reproduction and sterility; (b) investigate the possibility of obtaining a material from plants that can be used in place of the expensive pituitary hormones to treat certain types of sterility; and (c) determine whether the materials in plants might be active when administered by mouth.

A method of extracting and preparing an ovulating material from plant juices has been developed. The dry, powdered precipitate retains its potency for at least a year when stored at room temperature and is active in doses of about 1 milligram per kilogram in the rabbit. Injections of liquid solutions of the acid precipitate are quite toxic to rabbits, however, and further chemical purification is necessary before it can be determined whether this is caused by the substance that produces ovulation or by some impurity. If the toxic effects can be shown to be due to a contaminating substance, the purified ovulating factor may prove to be a useful drug to stimulate an inactive pituitary to more normal function.

Hormones that affect milk production: Experiments by the Bureau of Dairy Industry during the year indicate that Diethylstilbestrol, an inexpensive synthetic drug recently discovered in England, may provide a practical means of producing lactation in dairy cows under certain conditions. The natural hormones of the ovary, estrogen and progestin, have been isolated in pure crystalline form but they are still too expensive for practical use with cows. Diethylstilbestrol is available at only about 1 percent of the cost of the natural estrogens, and is equally potent.

In the Bureau's experiments, two Jerseys and a Holstein that had been dry for 4 to 6 months were chosen for treatment. All three had a poor breeding history and showed poor possibilities of ever calving again. After 3 months of treatment the Holstein was milked once a day and in 2 weeks her daily milk yield reached 12 pounds. During the next 2 months she was milked twice a day and her daily milk yield averaged 14 to 16 pounds. She had had 10 injections, in which about 20 cents worth of stilbestrol was used, when the milking was started; and she is now yielding about 400 pounds of milk per month. The two Jerseys were treated 1 and 2 months longer respectively than the Holstein, before milking was started. One has been in milk about a month, yielding 15 pounds a day. The other has just been started, and her yield is now 6 to 8 pounds a day.

Further investigation will be necessary to determine the optimum duration of treatment and dosage. When these factors have been studied it may be possible to simulate more nearly the conditions present during pregnancy and to induce a more normal lactation by this experimental procedure.

Nutritional investigations with dairy calves: It is estimated that the 6-1/2 million calves raised in this country in 1942 consumed approximately 3,290,000,000 pounds of whole milk, as well as large quantities of skim milk. It is common practice to feed skim milk to 6 months of age, which frequently requires 1,500 to 2,000 pounds per calf. Prior to the war, skim milk was plentiful. But now it is highly desirable to conserve skim milk as well as whole milk for human consumption.

In 1942 an experiment was started to determine how much skim milk it is actually necessary to feed along with ordinary grain and hay to raise a calf successfully. Twenty-seven calves were fed varying amounts of whole milk (10, 24, 60, and 200 pounds, including the colostrum) at the start, and they had access to a grain mixture and roughage from the time they were 10 days old. Cod-liver oil was fed when the whole milk feeding was discontinued before the calves would eat enough roughage to supply their vitamin A requirements. The skim milk feeding was generally discontinued at 3 months of age, but in a few instances at 2 months.

In every group of calves in this experiment, the average percentages of the "standard weight" at 5 or 6 months of age (i.e., 2 and 3 months after the skim milk had been discontinued) were greater than at the end of the skim milk-feeding period (i.e., at 3 months of age). The group that received 200 pounds of whole milk had practically reached standard weight

at 3 months of age and were 102 and 108 percent of standard weight at 5 and 6 months of age. The group that received 10 to 24 pounds of whole milk dropped from practically standard weight at birth to 82 percent of the standard, but by the time skim milk was discontinued at 3 months of age they had recovered to 87 percent of standard; whereas those of this group that reached 5 and 6 months of age were 94 and 100 percent of standard at these ages. There is, therefore, no definite evidence to lead one to anticipate any practical disadvantage at 5 or 6 months of age as a result of discontinuing skim milk at 3 months of age.

Investigations of Dairy-Herd-Improvement-Association
Practices in Relation to Efficiency of Production

Progress in association herds: Farmers in dairy-herd improvement associations are using the production records and other data that are made available to them through the operation of this project to (a) cull the unprofitable cows from their herds; (b) to feed the remaining cows more economically; and (c) to select the most desirable breeding animals. The culling and feeding practices, based on the use of records as a guide, have resulted in a considerable increase in the average production of association cows since the record-keeping program began. Some improvement has also been made in the inherent producing capacity of the association herds as a result of selecting better breeding stock, although many farmers, dairy leaders, and breeders have only recently begun to realize fully the value of using the association records for that purpose. Association members and State dairy leaders are now cooperating with the Bureau in conducting a Nation-wide dairy cattle breeding program based on the use of association records.

In 1942, cows in dairy-herd-improvement associations produced 8,323 pounds of milk and 339 pounds of butterfat on the average. In contrast, the average of all cows in the United States was 4,739 pounds of milk and 188 pounds of butterfat. The following table shows the improvement in the butterfat production average made in association herds from 1925 to 1942, inclusive:

<u>Year</u>	<u>Butterfat</u>	<u>Year</u>	<u>Butterfat</u>	<u>Year</u>	<u>Butterfat</u>
1925	284	1931	306	1937	320
1926	289	1932	310	1938	317
1927	293	1933	313	1939	323
1928	296	1934	322	1940	331
1929	298	1935	322	1941	335
1930	303	1936	319	1942	339

During the fiscal year 1943, the Bureau compiled proved-sire records for 2,278 sires used in the association herds. Copies of each proved-sire record were sent to the State extension dairyman in the State where the sire was proved, for transmittal to the owner of the sire, the local association tester, and the local county agent. Copy of the seventh printed

list of proved sires was prepared and published. This list includes the names and records of 1,226 proved sires whose records were tabulated between January 1, 1942 and January 1, 1943.

Progress in Nation-wide breeding program: The identification and production record project, under which identification and production records obtained in dairy-herd-improvement associations are used in proved-sire work, forms the basis for the Nation-wide, dairy-cattle breeding program.

During 1942 approximately 93 percent of the associations reported records to the Bureau for use in proved-sire work. The identification records are filed by the Bureau to form a genealogical or family-tree record of all association animals and the production records are analyzed to determine the breeding value of individual sires and family lines in association herds.

Approximately 400 identification records and 700 production records are received daily from the States for permanent recording by the Bureau. To date, approximately 1,250,000 association animals have been identified and their identification records have been recorded in the genealogical file.

Production records have been received and recorded by the Bureau for about 600,000 association cows. Dam-and-daughter data for proving sires are being accumulated on more than 85,000 sires used in association herds.

Data are being accumulated on approximately 25,000 association herds. These data are used in making genetic analyses to determine the breeding worth of the various families of animals within association herds. To date 982 herd analyses have been made.

Studies will be continued to bring about further refinement of the data and methods of tabulation and analysis in order that the true breeding worth of breeding stock of the association herds may be determined more accurately. The more accurate this determination, the more assurance dairy-men will have that the breeding stock they use will improve their herds.

Investigations for the Utilization of Milk in the Manufacture of Milk Products

Dried whole milk: The wartime demand for dried whole milk, which has more than quadrupled its production since 1940, created new problems of manufacture and packaging. The need to preserve the original qualities for longer periods is more acute and there are also new and inexperienced manufacturers in the field. In addition to helping these manufacturers by suggesting procedures based on past research knowledge, the Bureau continued to study the possibility of minimizing and preventing the deterioration of the product that results from oxidation of the fat.

Studies during the year showed that packaging dried whole milk in nitrogen, with the final oxygen content of the container reduced to 2 or 3 percent, greatly prolongs its keeping quality. Reducing the oxygen content sufficiently to improve the keeping quality still further is difficult. The degree of removal is dependent principally on the amount of vacuum used and the length of time it is applied. The conditions of evacuation necessary for efficient removal of the oxygen-containing gases were studied and established, and the exact relationship between oxygen concentration and keeping quality is being determined.

Agencies concerned with the shipment of dried milks for Lend-Lease and other purposes were provided with information indicating that considerable space could be saved by compressing the powders into block form, or by jolting the containers of bulk powder during the filling operation. The information was the result of tests made during the year, which established the extent to which whole milk and skim milk powders could be compressed and still retain their usability. From 30 to 40 percent reduction in space is feasible by compression, and 20 percent by jolting the container during filling.

Evaporated milk: The critical shortage of tin cans and other possible container materials has focused attention on the possibility of increasing the solids content of evaporated milk beyond the present standard of 26 percent, to permit the packaging of more food value per container.

Studies during the year showed that the stability to heat of concentrated milk during sterilization can be greatly increased if the milk is forewarmed at a relatively high temperature for a short period of time before it is concentrated. With an increase in the heat stability, it is possible to increase the concentration and still obtain an evaporated milk that will not coagulate when it is subjected to the heat of sterilization. It is possible with this type of forewarming treatment to manufacture evaporated milks with 31 to 32 percent solids content, or even greater concentrations, without the danger of coagulation.

Other difficulties, however, such as changes in color and body, and the separation of fat during unfavorable storage conditions, which are typical of the standard evaporated product, are intensified in evaporated milks of higher solids content. The storage characteristics of milks of standard content as well as milks of higher content are being studied. When evaporated milk of 31 percent solids content can be made commercially practical in these respects, its use will result in a saving of nearly 20 percent in container materials and shipping space.

Riboflavin (vitamin B₂) from whey: Inadequate supplies of riboflavin concentrates so far have prevented the enrichment of bread with this vitamin -- the vitamin most lacking in the average diet. Methods devised in the Bureau and elsewhere indicate that substantial quantities of riboflavin in suitable concentration for enriching bread can be obtained from cheese whey.

Liquid whey contains approximately 1.37 micrograms of riboflavin per gram and dried whey contains 22 micrograms per gram, but a concentration of about 250 micrograms per gram is needed so that 1 pound of the product will be adequate to enrich 100 pounds of flour.

The Bureau's research work has shown that, in the manufacture of milk sugar from whey, some of the riboflavin will absorb on some of the milk sugar, if suitable conditions of temperature and concentration of sugar and riboflavin are provided. By this method it is now possible to manufacture milk sugar containing 300 micrograms of riboflavin per gram of sugar, at approximately the cost of making milk sugar. This enriched milk sugar has been tested in bread with satisfactory results, and pilot-plant tests indicate that the method of production is practicable for large-scale operations.

A commercial process for increasing the riboflavin content of liquid whey, by bacterial action, and drying the enriched whey, which then contains 1,200 micrograms of riboflavin per gram, has been developed. From commercial samples of enriched dried whey, milk sugar has been produced which contains as much as 2,500 micrograms of riboflavin per gram of sugar. The riboflavin-enriched milk sugar is free of the salts that give dried whey an unpleasant taste and it also dissolves readily. Research will be continued with a view to improving the methods and adapting the results to industrial operations.

Alcohol and glycerin from whey: The increased need for alcohol in many industries, particularly in the synthetic rubber industry, emphasizes the importance of considering new sources of fermentable sugar, especially since much of the supply of low-grade molasses has been cut off. The 10 billion pounds of whey produced annually in this country is a potential source of sugar for the production of alcohol or other fermentation products.

The Bureau has developed a process, on a laboratory basis, for efficient conversion of the sugar of whey to alcohol by means of lactose-fermenting yeasts. Many members of this family of yeasts have been tried for this purpose and the most efficient ones selected.

The need for glycerine also rises sharply in wartimes and the quantity available from fats has rather definite limits. During the first World War, Germany is said to have produced glycerine on an industrial scale by the fermentation of glucose. If it is possible to cause the yeasts that ordinarily produce alcohol from glucose, to produce glycerine, it would seem possible to accomplish the same result with lactose-fermenting yeasts and thus be able to ferment the sugar of whey to glycerine.

So far the Bureau's efforts to produce glycerine from milk sugar have failed. But investigations of possible reasons for the failures have shown that certain of the B-vitamins that are destroyed by the bisulfites used as "steering" substances are necessary for the growth of lactose-fermenting yeasts. It has also been found that bisulfites form compounds

with glucose, lactose, and related sugars. This investigation is being continued.

Lacquer from whey: Further improvement was made during the year in the Bureau's method of making resin lacquer from lactic acid and castor oil, to replace tin as a protective coating material in the food industry. The time required to bake the lacquer was reduced from 40 minutes at 400° F. to 20 minutes at the same temperature, by incorporating suitable driers. The durability and elasticity of the lacquer were also improved.

Trial coatings of the lacquer on evaporated milk cans proved to be resistant to the usual processing treatment. On 10-gallon milk cans of "Bond-erized" iron, the lacquer was adequately durable except in the neck of the can where abraision caused wearing off. This lacquer proved more desirable for milk cans than coatings of the phenolic or vinylite types. Lacquer samples were prepared for tests by the War Department and industrial concerns, and in general, the tests proved that the lacquer is satisfactory for coating metal containers on which tin is customarily used.

Because of the shortage of castor oil, other oils were tried as a component of the resin. Hydroxylated linseed oil gave a greater yield of resin but a somewhat less resistant coating.

Cooperation with a number of industrial firms in the preparation and use of the lacquer resulted in its commercial production by one firm, and the prospects that others will soon be starting operations.

Conserving sugar in dairy products: Rationing of both sugar and dairy products to the ice-cream industry created a demand for information that would aid the ice-cream maker in conserving these materials and using substitutes efficiently, and also in maintaining good quality.

Study of the so-called "corn sweeteners" that have been available to the ice-cream maker showed that they are more effectively sweet in ice cream than had been realized. In fact dextrose, when used in conjunction with cane sugar, is more effectively sweet than the cane sugar it replaces.

The limited quantity of milk solids allotted to manufacturers of frozen desserts has created new interest in sherbets as a means of conserving the available milk solids. The sweetness of sherbets was studied during the year, as were other problems incident to their manufacture. Sweetness, however, is markedly reduced by increased acidity, while acidity is reduced very little by increased sugar content. The lowest acid content that is satisfactory requires the least sugar. If a sherbet is deficient in either acid or sugar, it tastes flat.

The results of these investigations have been published and have given a very clear and complete picture of the factors affecting the sweetness of frozen desserts and have indicated means by which sugar can be saved through efficient utilization and substitution.

Work is continuing on problems of sherbet manufacture. A study of the factors incident to the efficient utilization of all available milk solids has been started.

Faster-curing cheese: Manufacturers of Cheddar cheese may soon be able to make cheese that will ripen in about half the time now required. Speeding up the rate of ripening would give the young cheese used for Lend-Lease shipment much more flavor by the time it arrives overseas, and it would also save time and labor in curing "aged" cheese for domestic consumers. Ordinarily, Cheddar cheese requires at least 6 months to develop a pronounced or characteristic flavor.

It is generally recognized that the chemical and physical changes that occur in cheese during the ripening period depend on the bacterial content and growth. During the past year, studies were made of the effects of different kinds of bacteria used as starters, the percentage of starter, differences in the amount of acid formed during the making and curing processes, and the curing temperature on the rate of ripening, the amount of flavor, the changes in physical properties of the curd, and the final quality of the cheese.

Although the investigation is not yet completed, the results to date show that the rate and extent of ripening are affected greatly by the curing temperature... Apparently the ripening process can be carried out successfully and more quickly at 60° F., or slightly less, than at 50° F., or lower, provided the milk is of good quality and is pasteurized. Also, certain species of lactobacilli, when used as auxiliary starters, were found to be more effective than others in producing a desirable flavor, body, and texture, and some strains accomplished these results in much less time than others. The combination of special starters and a curing temperature of about 60° F. promises to be a practical way of reducing the ripening period from about 6 months to 3 months.

Technical assistance to cheese manufacturers: The Bureau demonstrated its methods of making high-quality Cheddar cheese and rendered technical assistance to 20 cheese factories in Minnesota, 21 in Michigan, and 23 in Indiana during the current year. Reports from 11 factories in Minnesota, where production records for the year were quite complete, indicate the effectiveness of the quality-improvement work. In these factories the production of No. 1 grade cheese was increased from 36 percent to 86 percent.

New method for dehydrating cheese: The urgent need to conserve shipping space and tonnage in transporting vital wartime foods stimulated interest in the dehydration of cheese, with the result that a method was devised in the Bureau's laboratories which permits the dehydration of natural, full-fat cheese without preliminary processing. The laboratory work has been completed on a test scale and plans are now being made rapidly to test the method on a semicommercial basis. A significant feature of the new method is that spray-drying equipment is not required, thus releasing critical equipment for other purposes.

The dehydrated product contains about 2.5 percent moisture, 50 percent fat, and 37 percent protein. Compared with the original cheese, the saving in weight is about 35 percent and the saving in shipping space, when the dehydrated flakes are compressed into rectangular blocks, is from 40 to 46 percent. It can be handled and used without waste, and it can be transported or stored without refrigeration if some ventilation is provided. Judged on the basis of a combination of all essential factors studied to date, including dryness, physical properties, flavor, and keeping qualities, the product is considered satisfactory and apparently meets Lend-Lease requirements.

New type of whey cheese: Approximately 80 percent of the 10 billion pounds of whey produced annually as a byproduct in cheese factories is fed to livestock or wasted. In an effort to conserve the valuable protein, carbohydrates, minerals, and vitamins of whey for human consumption, the Bureau's research workers have been studying the possibility of making whey-protein cheese. Some progress has been made in developing methods for precipitating the protein from the whey and in the use of special starters that may aid in the curing process. The use of a Roquefort-type mold produces a cheese closely resembling Gorgonzola and seems to offer the most promise.

(b) Special Research Fund, Department of Agriculture
(Allotment to Bureau of Dairy Industry)

This budget schedule covers obligations under an allotment for special dairy cattle and dairy products research.

(c) Working Fund (Bureau of Dairy Industry)

This budget schedule covers obligations under advances, pursuant to Section 601 of the Economy Act of June 30, 1932, for the development of dairy production and nutrition program in other American Republics.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS

Item	Obligations: 1943	Estimated obli- gations, 1944	Estimated obli- gations, 1945
<u>Special Research Fund, De-</u>			
<u>partment of Agriculture:</u>			
For dairy cattle and dairy			
production research	\$48,277	\$60,545	\$60,761
<u>Working Fund (Bureau of Dairy</u>			
<u>Industry) (Advance from Of-</u>			
<u>fice of Coordinator of Inter-</u>			
<u>American Affairs): For de-</u>			
velopment of dairy produc-			
tion and nutrition program in			
other American Republics ...	17,026	2,000	- -
Total Obligations under Supple-			
mental Funds.....	65,303	62,545	60,761

PASSENGER-CARRYING VEHICLES

The Bureau of Dairy Industry does not contemplate any expenditures for the purchase of passenger-carrying vehicles during the fiscal year 1945. It is expected that four vehicles will continue in operation.

AGRICULTURAL RESEARCH ADMINISTRATION

Bureau of Plant Industry, Soils, and Agricultural Engineering

(a) Preamble

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

For the investigation of fruits, fruit trees, grain, cotton, tobacco, vegetables, grasses, forage, drug, medicinal, poisonous, fiber, and other plants and plant industries, [and] of soils and soil-plant relationships, and of the application of engineering principles to agriculture, in cooperation with other branches of the Department, the State experiment stations, and practical farmers: ***

This proposed change in language inserts "and of the application of engineering principles to agriculture," since the functions performed under this authority were transferred to the Bureau of Plant Industry, Soils, and Agricultural Engineering by Agricultural Research Administrator's Memorandum No. 5 approved by the Secretary on February 13, 1943, pursuant to Executive Order 9069, dated February 23, 1942.

(b) General Administrative Expenses

Appropriation Act, 1944	\$209,709 <u>a/</u>
Anticipated deficiency for overtime pay required by the	
War Overtime Pay Act of 1943	<u>+15,291</u>
Total anticipated available, 1944	<u>225,000</u>
Budget estimate, 1945	<u>225,000</u>

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PROJECT STATEMENT

Project	: 1943	: 1944 :(estimated):	: 1945 :(estimated):	: Increase or decrease
1. General administration and business service	:\$206,597:	\$225,000:	\$225,000:	--
Unobligated balance	: 6,112:	- -:	- -:	--
Total available	: 212,709:	225,000:	225,000:	--
Transferred to:	:	:	:	:
"Salaries and expenses, Office of Administrator, Agricultural Research Administration"	: +12,000:	- -:	- -:	:
"Salaries and expenses, library"	: +18,280:	- -:	- -:	:
Anticipated deficiency for overtime pay	: - -:	-15,291:	- -:	:
Total estimate or appropria- tion	: 242,989:	209,709:	225,000:	:

a/ Includes \$26,279 transferred pursuant to Executive Order 9069 from the appropriation "Salaries and expenses, agricultural and industrial chemistry, Agricultural Research Administration," general administrative expenses.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	: 13,117:	\$17,740:	\$18,210
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	: 3,000:	15,291:	15,291
Total cost of overtime (7 months in 1943) ..	: 16,117:	33,031:	33,501

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

This appropriation provides for the direction of the research work of the Bureau of Plant Industry, Soils, and Agricultural Engineering, general administration and supervision of fiscal, property, and personnel work, and the administrative review and preparation of research and other publications.

(c) Agricultural Engineering Investigations

Appropriation Act, 1944 (appropriated under Bureau of Agricultural and Industrial Chemistry)	\$257,128
1943 appropriation made available in 1944	+20,000
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+36,511
Total anticipated available, 1944	313,639
Budget estimate, 1945	293,639
Decrease	<u>-20,000</u>

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Advice and assistance ...	\$ 13,979:	\$ 24,140:	\$ 24,140 :	- -
2. Farm mechanical equipment :	102,916:	91,776:	91,776:	- -
3. Farm structures and related investigations	50,596:	45,815:	45,815:	- -
4. Mechanical processing of farm products	128,339:	146,053:	126,053:	-\$20,000 (1)
5. Rural electrification investigations	4,350:	5,855:	5,855:	- -
Covered into Treasury in accordance with Public Law 674	829:	- -	- -	- -
Unobligated balance	27,324:	- -	- -	- -
Total available	<u>328,333:</u>	<u>313,639:</u>	<u>293,639:</u>	<u>-20,000</u>
Transferred to "Salaries and expenses, library" ...	+5,400:	- -	- -	- -
1943 appropriation made available in 1944	+20,000:	-20,000:	- -	- -
Anticipated deficiency for overtime pay	- -	-36,511:	- -	- -
Total estimate or appropriation	<u>353,733:</u>	<u>257,128:</u>	<u>293,639:</u>	

DECREASE

- (1) The decrease of \$20,000 in available funds under this item for 1945 is due to the elimination of a nonrecurring item reappropriated in 1944 for construction of a water-tower fire protection system at Stoneville, Mississippi.

The estimates for 1945 propose the deletion of the following language from this item:

"together with the unobligated balance of the funds made available under this head for the fiscal year 1943 for the construction of a water-tower fire protection system at the United States Cotton Ginning Laboratory, Stoneville, Mississippi, to be available for the same purpose in 1944."

This language reappropriated \$20,000 for a nonrecurring item, and it is expected that the funds will be obligated during the fiscal year 1944.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$21,274	\$7,314	\$8,147
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	- -	36,511	36,511
Total cost of overtime (7 months in 1943) ...	21,274	43,825	44,658

WORK UNDER THIS APPROPRIATION

Objective: The broad objectives of the agricultural engineering work are to increase efficiency in farming operations, reduce labor requirements, improve primary processing methods, provide for more economical and efficient placement and use of fertilizers, and develop safe storage facilities for field crops and vegetables. More specific objectives are: (a) To improve existing and develop new types of farm machinery for producing staple and special war crops; (b) to develop improved storages for war crops; (c) to assist in providing needed wartime supplies of important fibers through the development of improved methods of cotton ginning, fiber flax processing, and sansevieria processing; (d) to extend the uses of electricity on farms; (e) to give advice and assistance on agricultural engineering problems; and (f) to prepare and distribute bulletins, building plans, and other farm engineering information.

The Problem and its Significance: Agriculture in wartime is called on for the maximum production of food crops with a minimum of labor and a scarcity of machines and equipment. Special crops are required to provide new sources of war materials and crops heretofore grown in small volume must be expanded to produce the tremendous quantities required in modern warfare. Provision must be made for the safe storage of field crops and vegetables so they can be held without unnecessary losses and can be marketed in an orderly manner to meet military and civilian needs. Agricultural engineering research assists with all of these problems by developing and advising on more efficient methods of handling available machinery and adapting it to new uses; designing new machinery to produce, harvest, and process new war products; improving machines and equipment to maintain the natural quality of farm products; and developing safe storages for field crops and vegetables.

General Plan: Work is conducted at the following four government-owned laboratories: Auburn, Alabama, for research in farm machinery; Stoneville, Mississippi, for developing improved methods of ginning cotton; Beltsville, Maryland, for fertilizer placement machinery; and Ames, Iowa, for the study of problems in the storage of wheat, corn, sorghum,

and Irish potatoes. Other laboratories and machine shops are located in buildings owned by cooperators, including the Flax Processing Laboratory at Corvallis, Oregon; the project on mechanical control of insects and pests at Toledo, Ohio; the project on potato storage at Fort Collins, Colorado; and the project on sweetpotato production machinery at Ellisville, Mississippi. Almost the entire research program is carried on in cooperation with State and other agencies, there being twenty-one co-operative agreements with State agencies.

Examples of Progress and Current Program:

Advice and assistance: The results of research in the field of agricultural engineering have been prepared for publication in various forms for advice and assistance in the war program of the Department. The Bureau is cooperating with the Extension Service in providing the technical background and plans of organization for Extension projects on the wartime maintenance of farm machinery, the repair and maintenance of farm structures, safety measures on the farm, and methods of saving labor in farm operations. A manual for the use of rural firefighting organizations is being prepared. Assistance has been given to the War Production Board by the preparation of plans for white and sweetpotato storages constructed, so far as possible, of noncritical materials. Help has also been afforded war agencies in connection with the requirements, allocations, and purchases of farm machinery and farm building supplies.

Farm Mechanical Equipment: The work on farm mechanical equipment, designed to determine the most advantageous use of power, machinery, and labor in the production of agricultural crops, has been carried on under three main heads: (a) Pest and plant disease control machinery; (b) fertilizer distributing machinery; and (c) Power and machinery in crop production.

Pest and plant-disease control machinery: The protection of crops from damage by insects and diseases with a minimum use of insecticides and fungicides is essential if an adequate food supply is to be maintained on our available crop acreage. With this in mind a self-propelled machine was developed for field scale application of fungicides and insecticides to cover a wide range of conditions involving the use of (a) hydraulic spray, (b) dusting with air blast, and (c) air atomized spray of highly concentrated materials. Preliminary trials with this machine demonstrated its usefulness in establishing basic facts related to control materials, dosages, and methods. Further research in the control of the European corn borer infestation of sweet corn with another machine developed by the Bureau indicates that the machine can be employed effectively for the application of insecticides, with increased yields of No. 1 borer-free ears ranging from 220% to 350% as compared with untreated check plots. In laboratory studies of the physical characteristics affecting the performance of insecticide and fungicide dusts, it was found, under regulated air movement and controlled dust-feed rate, that the air-dust ratio affects the degree of separation of particles of unlike physical characteristics. This results in a partial separation of inert

From active ingredient. The correct air-dust ratio to prevent this separation is being sought.

Fertilizer distributing machinery: The establishment of fundamental data on the proper placement of fertilizers in the soil for specific crops is indispensable as an aid to the design of efficient distributing equipment which in turn contributes to the economical use of fertilizer. As a result of the fertilizer placement machinery research an increase of 29% in the yield of peas on experimental plots planted by a Bureau developed machine was realized last year over common practice in Washington State; a 12% to 15% increase in yield of tomatoes; a 20% increase in yield of sweetpotatoes; and a 20% increase in yield of Irish potatoes. Nationwide increases in this proportion would no doubt meet the increased agricultural goals without the need for extending acreages. Other fertilizer studies show in part that man labor for row marking, fertilizing, bedding, dragging, and planting such crops as cotton in the southeastern States is reduced by 80% and horse labor is reduced 51% by performing these operations simultaneously instead of separately as is the general practice. Last year cooperative work was carried on with the following State Experiment Stations: New York, on tomatoes, cabbage, canning corn; Maryland, tomatoes, canning corn; Virginia, tomatoes, peanuts; North Carolina, small machinery--labor saving; Mississippi, cotton--placement of phosphate; Michigan, peas, sugar beets, soybeans, field corn; Minnesota, peas; Washington, spinach, carrots, red beets, sweet corn, peas. Emphasis is being placed on crops for which increased production in the war effort is needed.

Power and machinery in crop production: The importance of mechanization in producing starch sweetpotatoes as set forth in cost data secured on this project last year show that field operations constitute 45% of total production costs on farms using specialized one-row equipment and 68% of total production costs on farms having no specialized equipment. Transplanting the crop alone, normally requiring 40 man-hours per acre, can be accomplished with 3 man-hours of labor by use of commercial tools modified by Bureau engineers. A transplanter of new and improved design was built from junk auto parts for the benefit of operators desiring but being unable to acquire a new machine. Adaptation of the white potato digger to the requirements in harvesting starch sweet potatoes, development of types of diggers fitted for work on different soil types, and a machine for the removal of vines from the bed preparatory to harvesting the sweetpotatoes have been in progress.

Shortages of edible oils and drying oils for paints and varnishes created by the falling off of imports, have created a demand for such products from domestic crops such as castor beans and peanuts, whose extended production in this country has introduced problems in production machinery. Development of a successful castor bean huller by this Bureau was instrumental in solving the bottleneck in the production of this crop, and the activities and funds for the work are being transferred to tung nut gathering and hulling machinery research which offers an undeveloped field. A tung nut huller, based on the principles used

in walnut hullers is now under development. Considerable progress has been made in peanut production machinery but much is yet to be accomplished in harvesting, picking, and shelling equipment. A machine operated by one mule has been developed to open beds and plant the peanuts in one operation at considerable savings in labor over methods in common usage; a combination harvesting machine is under development which digs the peanuts and shakes out the dirt in one operation thereby indicating a possibility of eliminating the labor otherwise needed to pull and shake the peanuts as they are dug.

Approximately 20 acres of crops consisting of corn, oats, peanuts, castor beans, cowpeas, and crotalaria were grown on an area near Auburn, Alabama, using tillage methods that tended to keep the residue of the previous crop on the surface for soil and moisture conservation. Sweeps, developed for this purpose, permitted putting the soil in good friable condition and controlling weed growth, yet retaining a high percentage of crop residue uniformly distributed on the surface. On the hillside areas these residues noticeably reduced erosion. These studies are in cooperation with the Soil Conservation Service and are also being carried on at Soil Conservation Service Stations at Nebraska, Iowa, Indiana, Illinois, Michigan, and Oklahoma where the machinery phases of the work are being coordinated by this Bureau.

Advice is being given on the merits of newly developed farm machinery and in making an appraisal of the quantities of various new machines needed to meet crop production goals as they are set. Technical assistance is also being rendered to the committee charged with the national program of maintenance and repair of farm machinery. Continuation of the performance studies of substitute binder twine in binders is in progress. Manufacturers have not as yet found a suitable extender with which to augment their 1944 stocks although several twines already tested indicate promise.

Farm Structures and Related Investigations: Work under this project has been limited to an investigation of storages for potatoes and other war foods. The storage work on potatoes, onions, and other vegetables has been centered at Fort Collins, Colorado, with outlying substations in adjoining States. At the request of the War Production Board and the War Food Administration, standard storages for Irish and sweet potatoes were designed, using a minimum of critical materials, and formed the basis for the storage program conducted by these agencies. In general, plans for potato and onion storage buildings have been developed which will reduce losses in storage from about 20% to 5%. The wartime shortage of burlap sacks has made it essential that the potatoes be stored either in wooden crates or in bulk. In the San Luis Valley of Colorado it was found possible to store 4,000,000 bushels of potatoes in bulk in tight bins with wall circulation of air with a minimum of loss. Crates and packing boxes are also scarce but, where available, their use saves more potatoes than bulk storage. This was shown by tests in Nebraska where the net profit in favor of box storage was about 5%. Tests of storing potatoes in

treated and untreated bags to prevent sprouting have been inconclusive since some of the treatments used on the bags ruined the taste of the potato. Attempts are being made to waterproof cotton sacks for shipping purposes. Plans are being prepared for small storage structures, both under and above ground, for storing vegetables from the farm garden in order that farmers may save their home-grown foods with a minimum loss.

Current studies on the storage of ear corn have developed the fact that pressure or downdraft ventilation is the best method for drying high moisture ear corn. A number of observations have been made of drying high moisture shelled corn in both naturally and mechanically ventilated bins, and safe widths for corn cribs under various climatic conditions have been determined. Preliminary studies show that corn to the depth of four feet with an initial moisture content of 20% will dry to a safe moisture content before any appreciable spoilage occurs. Where the moisture content is not over 20%, mechanical ventilation is not necessary.

One of the most promising developments in the investigation of the storage of wheat has been the discovery that, if the bins are painted white, the interior temperatures will be lowered about 10 degrees. During the spring and early summer months, this difference in temperature has been sufficient to prevent the infestation of the wheat by insects and consequently has had a major effect on the retention of quality by the wheat in storage. The storage of both small grain and corn on farms is of particular importance at this time because of the large quantities being produced under the war food program and the unavailability of terminal and other commercial storage. Early in the war metal bins became unobtainable and now certain kinds of lumber are on the critical list, so that investigations are now being made of various substitute materials in farm storages. A number of new types of grain bins utilizing new materials are being developed. Some are of radically different design as, for instance, multiple bins like the cells in a honeycomb, saving wall material and effecting economy. New types of roofs are being tried out, and a sixteen-sided bin of the demountable type which uses a minimum amount of lumber and nails is being studied.

Mechanical Processing of Farm Products:

Cotton ginning investigations: All resources of the Cotton Ginning Laboratory at Stoneville, Mississippi, are being used to increase the quantity of cotton of the quality needed in the war effort. This is being accomplished by perfecting a variety of operations in the ginning process which will preserve, rather than destroy, the natural qualities of the seed cotton. Among the most effective of these devices has been the development of a pneumatic conveyor system for use on roller gins to handle Sea Island and American-Egyptian cotton whereby the lint is carried directly from the roller to the press box without injury to the lint. The usual practice is to dump the lint as it comes from the roller on to the floor and carry it by hand to the press box. The new system not only keeps the fiber much cleaner but speeds up the operation and

reduces handling charges. The Cotton Ginning Laboratory has developed a design for a higher speed crankshaft and bearing assembly which not only has the effect of increasing roller gin capacities as much as 40% over present equipment, but eliminates several minor difficulties through better lubrication. Since the acreage of extra long staple cottons, because of the war demand, has been increasing faster than the capacities of the gins, this improvement is of major importance. During recent years manufacturers of cotton ginning equipment have developed systems for cleaning and drying cotton for the larger gins, but this equipment is all too large and too expensive for the small one- and two-stand gins which are common in all sections of the Cotton Belt, particularly in the Southeastern States. The Laboratory has developed a combination cleaner-drier-extractor to service these small gins which promises to do for the small gins what the expensive equipment does for the larger gins. This apparatus is being tested in commercial gins at the present time. A direct-heat oil and gas-burning furnace has been developed which uses a minimum of critical materials and has proven a satisfactory source of heat for the drying of cotton, corn, and other farm products.

Fiber flax processing investigations: The war has almost completely cut off the importation of flax fiber from European sources, leaving Oregon as the sole North American source of supply of flax fiber, which is in large demand for the manufacture of many articles used by the armed forces. Higher fiber prices, war needs, and the fact that the Bureau engineers have been able to develop efficient labor-saving machinery have resulted in a large expansion of the domestic flax industry. In 1938 there were four mills in Oregon processing the crop of from 3,000 to 4,000 acres; while in 1942 twelve mills were in operation, taking care of the production of some 18,000 acres of fiber flax. Two additional mills are under construction at this time. The Bureau's program has been successful in making many improvements in all phases of the industry, from the harvesting of the plant to the final processing. Nearly all the improvements developed by our research have been incorporated in all the mills, both old and new, because their usefulness in saving labor and improving the quality of the product has been so clearly evident. At present, attention is concentrated on improvements in scutching machines which separate the fiber from the woody part of the flax stem. Improvements have been made, but even with the best of present machines a considerable part of the fiber is lost during this process. If even 10% of this lost fiber could be retained, it would mean a large saving of badly needed material. The problem of making a more useful product from the tow, which contains the waste fiber, has also received considerable attention. A relatively inexpensive tow cleaner has been developed and tested under commercial conditions at various mills. It is much more efficient than the machines formerly used in that a much larger quantity of foreign material is removed from the tow. Formerly, the tow was so dirty and contained so much trash that there was little or no sale for it, but the tow cleaned with the Division's machine has sold for as much as \$260.00 per ton, thus resulting in a considerable increase in growers' returns. A fiber flax combine for pulling, deseeding, seed

cleaning, and binding flax straw in one operation in the field has been developed. While not yet perfected, the possibilities of reducing the labor required in harvesting and deseeding the flax straw are promising.

Hemp investigations: The study of existing hemp processing plants started in 1942 was completed in the fiscal year 1943. Under this project a study has been made of present methods used for processing hemp fiber in this country, and improvements for these machines have been devised particularly for the driers used in connection with decorticating. At the request of the W.P.B., the Commodity Credit Corporation set up an operating subsidiary corporation to produce hemp fiber. The operations of this production corporation include the construction of some 42 mills, for processing hemp. The research on this project has been used in improving machines for these mills. Standard plans have been prepared for plants with a capacity per plant based on the production of 4,000 acres of hemp, and involving the use of the improved machinery developed under this project. Assistance was rendered in negotiating contracts and agreements with various governmental agencies covering the financing and operation of the plants and the machine features of growing the acreage of hemp required. Without the basic research work and the careful planning of all engineering details which this project made possible, it is doubtful that the production of this valuable war material could have been successfully put through without serious losses, and it is certain that the production of fiber would have been considerably delayed if this preliminary work had not been done.

Sansevieria fiber processing investigations: The needs of the Army and the Navy, together with civilian requirements for a dependable supply of high-grade rope and cordage, make it imperative that all possible sources of satisfactory substitutes for manila hemp receive careful investigation. Sansevieria, the only hard fiber which can be grown in the United States, has many qualities which make it a promising substitute for abaca, particularly in that it does not swell when wet and is not affected by salt water. It has never been produced in commercial quantities in the Western Hemisphere, although some fiber has been processed experimentally in Latin America. It is known that it can be processed on the heavy machines used for henequen and sisal, but since the leaf is much lighter it is thought that lighter machines would be equally effective and much more economical to operate. Studies have been made of small-scale processing operations in Mexico and Cuba, and plans are being made to design and construct an experimental machine for processing this fiber. The Division of Cotton and Other Fiber Crops and Diseases, under cooperative agreements, is conducting experiments on growing the crop, and it is hoped that the combined experiments may develop a hard fiber plant which can be grown in this country and so handled as to provide a suitable replacement of abaca.

Rural Electrification Investigations: Work under this project consists largely of studies of the use of electric power in a cooling process for eggs on the farm whereby the eggs may be kept at optimum temperatures until marketed. Reliable data show that fully 5% of all eggs produced

are lost somewhere between the nest and the table. This is a staggering total when considering that the national production goal is almost 5,000,000,000 dozen eggs annually, and the 5% loss would amount to about 240,000,000 dozen. Eggs are so important in the wartime diet that such losses must be kept as low as possible. Fifty-two percent of the egg production occurs during the summer months when conditions for safe storage are at their worst. This work has shown that eggs in cool storage cabinets can be kept in good marketable condition for a week if necessary. These cabinets are water cooled and the cost of operation is very small, especially since the water can be used for watering livestock, garden irrigation, and many other purposes after it has been used for egg cooling. The use of burlap curtains, kept wet for cooling by evaporation, is being investigated in this connection.

(d) Cereal Crops and Diseases

Appropriation Act, 1944	\$562,255 a/
Proposed transfer in 1945 estimates from "Salaries and expenses, agricultural and industrial chemistry, Agricultural Research Administration" agricultural chemical investigations (for evaluating cereal varieties for food and other uses)	+26,201
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+80,100
Total anticipated available, 1944	668,556
Budget estimate, 1945	645,596
Decrease	<u>-22,960</u>

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Cereal production, breeding, disease, and quality investigations:				
(a) Barley	\$ 66,600:	\$ 72,100:	\$ 66,944:	-\$ 5,156
(b) Corn	165,815:	170,825:	160,791:	-10,034
(c) Seed flax	32,000:	33,440:	32,912:	-528
(d) Grain sorghum	35,900:	38,205:	37,535:	-670
(e) Oats	41,900:	39,535:	38,857:	-678
(f) Rice	43,300:	45,065:	45,065:	-
(g) Wheat	215,500:	224,276:	218,382:	-5,894
(h) Weed investigations to develop control methods.	39,057:	45,110:	45,110:	-
Covered into Treasury in accordance with Public Law 674	1,535:	-	-	-
Unobligated balance	9,174:	-	-	-
Total available	<u>650,781:</u>	<u>668,556:</u>	<u>645,596:</u>	<u>-22,960 (1)</u>

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
Transfer in 1945 estimates				
from "Salaries and expenses,				
agricultural and industrial:				
chemistry, Agricultural Re-				
search Administration,"				
agricultural chemical				
investigations	-26,201:	-26,201:	- -:	
Transferred to "Salaries and				
expenses, Office of Admin-				
istrator, Agricultural				
Research Administration" .	+2,500:	- -:	- -:	
Anticipated deficiency for				
overtime pay	- -:	-80,100:	- -:	
Total estimate or				
appropriation	627,080:	562,255:	645,596:	

a/ Includes \$15,185 transferred pursuant to Executive Order 9069 of February 23, 1942 from the appropriation "Salaries and expenses, agricultural and industrial chemistry, Agricultural Research Administration" agricultural chemical investigations.

Note: The Budget estimates for 1945 include a proposed transfer of \$26,201 to this appropriation from the item "Salaries and expenses, agricultural and industrial chemistry, Agricultural Research Administration," agricultural chemical investigations, in connection with the proposed transfer to the Bureau of Plant Industry, Soils, and Agricultural Engineering of investigations relating to evaluation of cereal varieties for food and other uses. A corresponding reduction of \$26,201 has been used in the estimate for the item from which the transfer is proposed.

DECREASE

(1) The decrease of \$22,960 in this item for 1945, distributed by projects as indicated above, contemplates discontinuance of cereal production, breeding, disease, and quality investigations at the State Substation, Dickinson, North Dakota; and curtailment of work conducted in cooperation with 6 other State agricultural experiment stations and at the Plant Industry Experiment Farm.

The estimated distribution of the decrease by locations is as follows:

Colorado, Akron	\$ 150	Oklahoma, Stillwater	\$ 100
Maryland, Beltsville	13,384	Texas, Beaumont	100
New Mexico, Tucumcari ...	150	Texas, Big Spring	170
North Dakota, Dickinson .	4,778	Wisconsin, Madison	4,128
			22,960

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	*\$10,584:	\$8,158:	\$8,158
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	32,000:	80,100:	77,140
Total cost of overtime (7 months in 1943) ..	42,584:	88,258:	85,298

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: The central purposes of the work on cereal crops are to insure the production, under wartime shortages of labor, equipment, and fertilizers, of the increased quantities of grain and seed flax needed by the United States and her Allies for food, feed, alcohol, drying oil, and other industrial purposes, and to improve the value of these crops for special needs. More specific objectives are: (a) To adapt cultural, cropping, and harvesting methods so as to meet emergency conditions; (b) to increase and distribute new varieties better adapted to avoid the diseases and other hazards threatening production in different parts of the country; (c) to develop methods for controlling diseases and pests; (d) to develop varieties with special characteristics (such as corn and sorghum with waxy starch) to meet new industrial requirements or to fill requirements previously met by imported products; and (e) to devise practical systems of culture, cropping, and chemical treatments for the control of noxious weeds which reduce wartime production and increase costs.

The Problem and its Significance: Unpredictable fluctuation in the yield and quality of the grain crops is a seriously disturbing element in our national economy, even in normal times. Failure to get maximum production of needed crops under war shortages of labor, equipment, and fertilizers may be extremely serious. Most of these fluctuations are due to losses from diseases and insect pests, and to the effects of cold, heat, or drought. As an example, stem rust of wheat in 1904, 1916, 1935, and 1937 caused losses in excess of \$100,000,000 each year. In 1938 a combination of stem rust, leaf rust, and heat resulted in an equally serious cut in spring wheat and oat yields. In the winter of 1939-40, nearly 20% of winter wheat sowings were lost from winter-killing. The normal loss amounts to 10%. Other diseases and heat and drought are added hazards... Destructive new diseases are introduced from foreign countries from time to time, and old diseases cause more severe losses as soil conditions, such as humus and plant food content and attendant physical conditions, change with longer cultivation of farm lands. The seriousness of disease losses is increased by the fact that such losses are not equally distributed, but may wipe out almost the entire crops of individual producers or even entire producing sections.

Research has demonstrated that breeding can develop for each area strains of the different crops, which because of disease resistance or better adaptation to other prevailing conditions, may greatly reduce fluctuations in yield and quality. Improvements in cropping and cultural methods and seed treatments also reduce hazards; for example, proper methods and time of seeding will reduce losses from winter-killing. Proper attention to all of these considerations opens the way through research for more certain production of these basic crops. The importance of certain cereal products is increased during the emergency by the possibility of their use as substitutes for essential plant materials no longer available from imports; as for example, waxy corn and sorghum to replace waxy starch formerly obtained from cassava grown in the Orient. Goals for the

production of livestock to meet domestic, military, and Lend-Lease needs are limited by the quantity of feed grain that can be produced. Production can be greatly increased by more extensive use of improved varieties and practices without resorting to the practice, which in the past has proven so disastrous, of plowing up grassland in the drier sections of the Plains.

Weeds are estimated to cause an annual loss through reduced yields, lowered crop quality, costs of control, etc., in excess of \$1,000,000,000, and by some authorities as much as \$3,000,000,000. Noxious weeds, particularly difficult to control, threaten the continued use of extensive valuable acreages. Land values, tax structures, etc., are seriously impaired by these pests.

General Plan: Research on improvement in cultural and cropping methods, disease control, breeding, and on methods to avoid various hazards, is conducted throughout the United States in the regions where the different crops are important. This includes work at central points where special equipment is made available for intensive studies on diseases and for developing information on cold, heat, and drought resistance, for field use and in the breeding program, and also work in the field. During the war emergency, special emphasis is being placed on making available to farmers and agricultural workers information on problems brought about by shortages of labor, fertilizers, seed, metallic fungicides, etc. Technical information and assistance are given to the action agencies in developing production goals, fertilizer allotments, and similar programs. Arrangements are made, in cooperation with other Federal agencies and with State experiment stations and extension services, to insure adequate wartime seed supplies of improved cereal varieties, and to increase as rapidly as possible seed of new improved types. The completion of certain phases of work and the discontinuance for the emergency period of phases of work less directly connected with the war effort have made it possible to handle the new work with existing facilities.

The entire program is cooperative with the State agricultural experiment stations, and much material and information are supplied to the State stations even when there is no formal cooperation. Formal cooperation is maintained with the States and work is conducted in New York, West Virginia, North Carolina, Georgia, Tennessee, Mississippi, Louisiana, Arkansas, Missouri, Ohio, Indiana, Illinois, Wisconsin, Iowa, Minnesota, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Arizona, California, Nevada, Utah, Idaho, Montana, Oregon, and Washington.

Examples of Progress and Current Program:

Barley investigations: Barley, increasingly important in recent years, is playing a vital role in the war program by supplying feed grain and the necessary malt for making industrial alcohol from grains. The acreage of barley in 1943 reached a total of 15,106,000 acres, compared with the 1932-41 average of 11,120,000 acres.

The winter barley acreage in the South increased from 427,000 acres in 1929 to 1,750,000 acres in 1942. This increased barley acreage and the larger yields per acre that come with improved varieties are important factors in providing grain for the expanding livestock industry of the South. Sunrise and Davidson, varieties distributed as a result of the cooperative program in North Carolina, are increasing rapidly. Sunrise is resistant to mildew, has very stiff straw, and is one of the very few awnless varieties grown in America.

Improved varieties of barley are also helping to provide the feed grain needed in other areas. In the intermountain areas of Utah, Idaho, and Arizona, Velvon is very popular--a smooth-awned, smut-resistant, productive variety with stiff straw. Since its development and distribution in cooperation with the Utah Station in 1937, barley acreage in that State has increased from 38,000 to nearly 200,000.

Special attention is being given to increasing seed stocks for farm use of the new varieties developed in the breeding program. Other improved varieties recently distributed are Compana in Montana, Beecher in Colorado, Wintex and Texan in Texas, and Rojo in California.

Corn investigations: Hybrid corn's part in meeting production goals is shown by the estimate that in 1943 the production of corn was 669 million bushels greater than it would have been if open pollinated varieties had been grown on the roughly 50,000,000 acres planted with hybrid seed. The use of hybrid corn continues to increase. A recent survey by the Bureau of Agricultural Economics indicates that in 1943 hybrid seed was planted on 49,964,000 acres, 52% of the corn acreage in the United States. The estimates show that hybrid corn occupies 99% of the total corn acreage in Iowa, 96% in Illinois and Indiana, 92% in Ohio, 88% in Minnesota, and 81% in Wisconsin. Disease- and insect-resistant hybrids, adapted for growing in the South, have recently been developed or are in process of development in cooperative investigations with the Louisiana, Tennessee, Georgia, North Carolina, and Mississippi Experiment Stations, and it is confidently expected that the acreage planted to hybrid seed in these States will also increase rapidly, with an increase in production corresponding to that realized in the Corn Belt.

Reserve seed stocks. A survey conducted in the spring of 1942 indicated seed stocks of foundation inbred lines and foundation single crosses were insufficient in some cases to meet the demand for 1942 plantings and to provide at the same time a safe carry-over as insurance against production hazards. The growers of hybrid seed corn include half a dozen very large producers. There are also many hundreds of small growers who produce about 50% of all hybrid seed corn but as a rule do not maintain their own reserve stocks of inbred lines and single crosses, depending largely on current supplies. Consequently, an adverse season resulting in reduced supplies of foundation stocks would seriously affect production of hybrid corn the following two or three years. To safeguard against such a catastrophe, arrangements were made with hybrid seed corn

producers in Iowa, Illinois, and Indiana for the production of foundation single crosses for purchase by the Commodity Credit Corporation. A total of 2912 bushels of seed of the parent single crosses used to produce the double crosses planted by Corn Belt Farmers has been delivered to that agency for storage as an insurance against a poor crop season.

As an additional insurance, approximately 130,000 hand pollinations were made during 1942 to produce reserve stocks of foundation inbred lines used as parents for foundation single cross parents of Corn Belt hybrids. The Agricultural Experiment Stations in Ohio, Indiana, and Iowa cooperated in this program. The seed produced will be held in reserve until needed. Additional stocks of some lines still too low in reserve supplies were increased in 1943.

Most of the smaller hybrid corn seed growers depend on the seed stocks produced in the Bureau's cooperative program for continuing their operations. All hybrid producers depend on the cooperative program for significant improvements either in seed stocks or in methods of producing hybrids. Major attention is, therefore, centered on producing the foundation stocks necessary to grow the Nation's corn crop, and on breeding operations necessary to meet immediately pressing problems affecting wartime production.

Waxy corn. The increase of seed stocks of waxy corn, Iowa Hybrid 939, has reached the point where hybrid seed will be available to plant any acreage required to meet needs of the starch industry in 1944. There were grown in 1943 in Iowa 1,950 acres of waxy corn for further tests by the industry, and 320 acres for the production of double-cross seed.

Hybrid popcorn. Indiana popcorn, Hybrid 31, has proved highly productive and of fine quality. The acreage devoted to producing seed of this hybrid in Indiana increased from 7 acres in 1941 to 60 acres in 1942. The demand for seed in 1943, however, was so great that it was not possible to fill all orders.

Cooperative research of this Bureau and the State agricultural experiment stations developed the principles and methods which have made possible the production of hybrid corn on a commercial scale. Hybrids adapted to all of the Corn Belt and adjacent States and to some of the Southern States are now in commercial production. In the earlier stages of breeding, vigor and productiveness were given primary consideration and only slight attention was given to insect and disease resistance. Now that hybrid corn is in extensive production, some hybrids have been found to be susceptible to certain diseases. This requires that resistance to these diseases be a part of breeding objectives. The European corn borer, also, has spread across the Corn Belt and is causing serious damage as far west as central Iowa. Losses caused by these pests in the Corn Belt, likewise, make imperative a concentration of effort on breeding for resistance to them. In the South, diseases and insects, especially those attacking the ears, are very destructive and resistance to both hazards is a major objective in the breeding programs in that area.

Seed flax investigations: Results of a long-time study, published during the past year, on climatic factors influencing seed yield of flax and the yield and quality of oil have proven of great value in determining the areas in which seed flax should be grown to meet wartime demands. These studies show that yield, oil content of the seed, and drying quality of the oil are all affected adversely by the higher temperatures during the period from blossoming to harvest. Increased acreages, it has therefore been pointed out, should be confined to areas where prevailing temperatures during the seed forming and maturing period are not above 90 degrees Fahrenheit for any length of time.

Continued profitable production of flax in the San Joaquin Valley of California has been assured through the development of two varieties (C. I. 463 and Rio), resistant to the anthracnose disease destructive to varieties previously grown.

Special attention is being given to increasing seed supplies of newly developed varieties resistant to rust, which has been destructive to flax in the Dakotas and Minnesota during the past two years. These new varieties are also resistant to wilt and give high yields of good quality oil. The increase and production of these new varieties should make an important contribution toward meeting the total oil requirements of the war effort.

Oat investigations: The total estimated oat acreage for 1943 was 42,654,000 acres, practically the same as in 1942. The rapid expansion in the acreage of new oat varieties resistant to the rusts and smuts is continuing, and prospects indicate that by 1944 seed will be available so that all areas in the Corn Belt and elsewhere will have adequate supplies of seed. Probably 25,000,000 bushels of the rust- and smut-resistant varieties were produced in the North Central States in 1942, and estimates indicate that two-thirds of the oat acreage in Iowa, half that in Wisconsin, a fourth the acreage in Illinois, and some half-million acres in adjoining States, or a total close to 7,000,000 acres was sown to these varieties in 1943. These oats, developed in cooperation with the States mentioned, are early maturing, highly productive, and resistant to the rusts and smuts. Compared with former standard varieties grown in this area, the new varieties yield some 10% more when rust is not serious and in the "rust years," 1938 and 1941, yielded nearly twice as much. Now that additional acres are needed for producing war emergency crops, these new varieties make possible a considerable reduction in oat acreage without appreciably reducing total production.

While the new varieties are resistant to the races of rust and smut commonly occurring in the areas for which they were bred, constant vigilance is being exercised to avoid serious loss from new races of the diseases that may appear from time to time, and to which these oats might be susceptible. Detection of new disease-producing races before they are widely distributed allows time to breed oat varieties resistant to the new races as well as to previously known races. During the crop season of 1942, an unusually large number, 14, of new races of crown rust were discovered in

various sections of the United States. A few of these attack some of the new varieties, but some available oat variety has been found resistant to each new race. By crossing such varieties with the improved sorts, new varieties resistant to both new and old races of the disease are obtained.

Increased production of livestock in the South requires an increased production of feed grain. The new rust- and smut-resistant varieties of winter oats, adapted for growing in this area, not only furnish much needed feed grain but also supply pasture and winter cover to prevent erosion. New varieties recently distributed in the Carolinas and in Texas are proving widely useful throughout the South.

Rice investigations: The war in the South Pacific has interrupted the normal movement of rice from Southeastern Asia to Europe and the Western Hemisphere. This situation has made it necessary to increase rice production in the United States to help meet the needs of the Allied Nations for this important food. In 1943 the rice acreage in this country was about 51% higher than for the 10-year period 1932-41.

The acreage of improved varieties of rice has been materially increased as a result of special attention being given to the increase and distribution of seed of new disease resistant varieties. Texas Patna, a new variety that matures 10 days earlier than Rexoro, is resistant to *Cercospora* leaf spot, yields and mills well, and is of excellent table quality. This new variety is meeting with favor among growers who have grown Rexoro, but prefer the earlier Texas Patna which is otherwise of the same type and yielding ability. Another variety, resistant to *Cercospora* leaf spot and white tip, recently distributed in the Southern States is Blue Rose 41, except for its disease-resistance very similar to the popular Blue Rose. The acreage sown to Zenith, an early-maturing variety resistant to blast and of better quality than Early Prolific, also has increased materially in the Southern States.

The continuous-submergence method of irrigation to control weeds, developed in cooperation with the California Station, has now become the standard method of growing rice on some 200,000 acres of old rice land in California. Prior to the development of this method of irrigation the cost of weeding rice fields was from \$3.00 to \$5.00 per acre.

Grain sorghum investigations: The pressing need for feed grains outside the Corn Belt has resulted in an increased acreage of grain sorghum. Sorghums were planted on 17,220,000 acres in 1943, nearly 13% more than the 1932-41 average; and it is expected that the acreage to be harvested for grain will be larger than ever before.

New improved varieties developed in cooperation with the Kansas, Texas, and Oklahoma Stations have helped materially to maintain and extend production. Early maturing dwarf types that can be harvested with a combine and are adapted for growing in South Dakota and Nebraska also have

greatly extended the area where grain sorghum can be grown successfully. Other combine types adapted for growing in Kansas, Oklahoma, and Texas have reduced the cost and labor required for production farther south. Some of these varieties resistant to Pythium and charcoal rot and to chinch bugs are materially reducing the losses from these pests.

Waxy sorghum. The development of waxy sorghum has been expedited in every way possible to meet the wartime needs for waxy starch for certain types of adhesives and for food--needs that may also be met with waxy corn. Waxy starch from each crop is satisfactory, and both have therefore been developed as possibilities. It is too early to determine the place of each crop in meeting industrial needs, but either can now be produced to meet the demands of industry. Grain sorghum varieties with waxy grain and without objectionable pigments in the seed have been developed and increased (by growing a winter crop in southern California) on some 20,000 acres in 1943. Production from this acreage will provide seed for any acreage desired in 1944, and also some starch for use by the industry this year.

Primary attention is being given to increasing seed supplies of improved varieties for the different areas.

Wheat investigations: Losses from stem rust in the spring-wheat area were negligible in 1943 because the acreage was largely seeded to the resistant varieties, Thatcher, Pilot, and Rival. Leaf rust, however, has become relatively more important, and the leaf-rust resistant Pilot and Rival are rapidly replacing the leaf-rust susceptible Thatcher which, because of its stem-rust resistance, was built up to some 18 million acres in the United States and Canada in 1941. Thatcher, while it did practically eliminate losses from stem rust, is so susceptible to the ordinarily less destructive leaf rust that losses from leaf rust have now become important, although they are still much less than the former losses from stem rust. Newthatch, a variety almost identical with Thatcher except for being resistant to leaf rust, is being increased in 1943 and will be distributed to farmers in 1944.

Two new high-quality, stem- and leaf-rust resistant durum wheats, Carleton and Stewart, were released to growers in the spring of 1942 and about 20,000 bushels of seed were produced in 1943. These two improved varieties promise to replace stem-rust susceptible varieties of durum wheat now being grown on approximately 2,000,000 acres in the Dakotas and Minnesota; Semolina, the flour from durum wheats, is used to manufacture macaroni, spaghetti, and similar products.

The early, high-yielding, leaf-rust resistant, hard red winter varieties, Comanche and Pawnee, which are being distributed in Kansas, Oklahoma, Texas, and Nebraska, should help materially in meeting the greatly increased wartime demand for wheat. The new leaf-rust resistant variety, Sanford, recently distributed in Georgia, is being extensively grown on the expanding wheat acreage in the South, where one of the limiting

factors in small-grain production in the past has been leaf-rust damage. Special attention has also been given in other areas to increasing seed of new improved varieties for commercial production, and in the Pacific Northwest particularly to guarding against the appearance of new stinking smut races attacking now available resistant wheats. In Utah, a new awnless hard red winter variety, Cache, resistant to dwarf bunt, has been distributed; and in Texas, the new variety of common winter wheat, Austin, resistant to stem and leaf rusts, has been distributed.

Special investigations begun in 1942 on the vitamin and mineral content of wheat have shown that there are distinct varietal differences in B₁ content, but they also indicate that environment is responsible for even greater differences. The application of these findings to improving the nutritional value of wheat products, however, is greatly complicated by the fact that present methods of milling and baking may largely eliminate inherent differences in the grain.

Results obtained during the last 2 years have shown that certain nonmetallic chemicals give satisfactory control of some seed-borne cereal diseases and could be safely substituted for fungicides containing critical materials, such as mercury and copper.

Weed investigations: As a result of research on this project, methods have been developed which reduce costs and labor for control of European bindweed on farms by one-half or more. Root-reserve studies have shown that the bindweed plants continue to reduce root reserves until they have reached a height of at least four inches. Following the lead of this information it has been possible to cut the number of cultivations to half the number formerly recommended. The studies have also shown the best time to begin cultivation for control. Special attention is now being given to making the results of this research available to experiment stations, extension workers, and farmers, and to assisting action agencies to develop sound programs for putting the results into use. As a result, satisfactory weed control methods have been and are being put into practice on hundreds of thousands of acres of land infested with bindweed, in Kansas, Iowa, Nebraska, Minnesota, Idaho, Oregon, Washington, and elsewhere, largely in grain-growing areas, but also on other lands. Crop production on much of this infested land has been materially increased.

Satisfactory methods for controlling bindweed through a reasonable number of cultivations are thus available for most areas where infestations of this weed are serious. Attention is therefore being given to working out recommendations to meet special problems in other areas where cropping and cultural practices are somewhat different. New practices to apply in combination with crop sequences are, for example, being tested to determine what crops can be best used as smother crops following partial control by cultivating. Winter wheat, winter rye, alfalfa, and substitutes for these crops where they are not adapted, are being tested.

Methods of control developed from research on bindweed, with minor modifications, are practical for the control of some other weeds similar in habit. The growth habits of the different weeds vary, however, and require changes in practice to meet these variations. Dates when growth starts in the spring, the period when root reserves are at a minimum, and other factors must thus be worked out for each weed before details of the most economical control methods can be developed. Research is being undertaken to develop methods for the control of white top, Russian knapweed, Johnson grass, and some other weeds. Losses from Johnson grass are especially severe, and very little careful research has been conducted to develop practical methods for its control. Hundreds of thousands of acres of productive land in the South are lost to cultivation, or yields are so low that cultivation is not profitable, because of severe infestations of Johnson grass. This control problem is complicated by the fact that individual farmers in some communities use it as a hay or pasture crop.

The limited quantities of the critical sodium chlorate and arsenic available for weed control have made necessary an extensive search for non-critical chemicals and the careful allocation of available supplies. Information supplied through the research program has been used as a basis for allocations by the W.P.B. Experimental tests during the past year have indicated that borax in combination with limited amounts of chlorate will give satisfactory control and may be a satisfactory substitute on nonagricultural lands.

(e) Cotton and Other Fiber Crops and Diseases

Appropriation Act, 1944	\$422,940
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+44,200
Total anticipated available, 1944	467,140
Budget estimate, 1945	456,702
Decrease	-10,438

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. Cotton production, breeding, and disease investigations:	:	:	:	:
(a) Cotton breeding and improvement investigations (including \$14,700 for Sea Island cotton)	:\$175,613:	\$183,890:	\$177,262:	-\$ 6,628 (1)

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
(b) Cotton quality investigations	54,300:	58,380:	58,380:	- -
(c) Cotton disease investigations	45,200:	46,894:	46,894:	- -
(d) Cotton culture, fertilizer, and nutrition investigations	27,200:	25,412:	21,602:	-3,810 (2)
(e) Farm use of improved seed stocks and one-variety community organization	80,380:	89,064:	89,064:	- -
Total, cotton production, breeding and disease investigations	382,693:	403,640:	393,202:	-10,438
2. Fiber plants other than cotton, investigations of:				
(a) Hard fiber investigations (abaca, sisal, henequen, yucca, etc.)	11,500:	19,750:	19,750:	- -
(b) Hemp, flax, ramie, urena, crotalaria, and miscellaneous fiber investigations	45,500:	43,750:	43,750:	- -
Total, fiber plants other than cotton, investigations of.	57,000:	63,500:	63,500:	- -
Covered into Treasury in accordance with Public Law 674	1,155:	- -	- -	- -
Unobligated balance	5,507:	- -	- -	- -
Total available	446,355:	467,140:	456,702:	-10,438
Transferred to "Salaries and expenses, Office of Administrator, Agricultural Research Administration" .	+2,000:	- -	- -	
Anticipated deficiency for overtime pay	- -	-44,200:	- -	
Total estimate or appropriation	448,355:	422,940:	456,702:	

DECREASES

The decrease of \$10,438 in this item for 1945 consists of:

(1) A decrease of \$6,628 due to curtailment of cotton breeding and improvement investigations at Beltsville, Maryland.

(2) A decrease of \$3,810 due to curtailment of cotton culture, fertilizer, and nutrition investigations at Auburn, Alabama.

Statement of Overtime Costs

	1943	:Est. 1944:	Est. 1945
Overtime absorbed	\$25,479:	\$10,919:	\$10,919
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945	- -:	44,200:	43,762
Total cost of overtime (7 months in 1943):	25,479:	55,119:	54,681

WORK UNDER THIS APPROPRIATION

General: Much of the work done under this appropriation pertains to cotton, its production, improvement, and diseases, while a smaller proportion pertains to other fiber crops such as hemp, flax, abaca, sisal, and henequen.

Objective: (a) The principal objective in connection with cotton under war conditions is to increase production of the kinds and qualities needed for making war materials by improving fiber quality, developing effective disease-control measures, and devising cultural methods that will increase efficiency of production while insuring to manufacturers of war materials the desired quality and uniformity of product.

(b) With wartime shortages of the important fibers formerly imported, another objective is to increase the production in the United States or elsewhere in the Western Hemisphere of abaca, hemp, sisal, and other fibers having a high use-value.

The Problem and its Significance: (a) Cotton normally is the most important agricultural export from the United States, and during wartime it is one of our most important raw materials. A shortage exists in supply of the better grades of long-staple cotton used for balloons, parachutes, rafts, tires, and other essential war uses. An American soldier on combat duty requires the equivalent of about 150 pounds of cotton annually for his equipment and maintenance, and some 11,000 items used by the army are made in whole or in part from cotton. More than 1,000,000 bales of linters are used in making cellulose for explosives and for other purposes. Cottonseed oil is of first importance in our supply of vegetable oils, and more than 2,000,000 tons of cottonseed meal are used annually as the principal concentrated protein feed for milk and beef production.

Cotton is the principal source of income for one-third of the total farm population of this country. How to keep the cotton-producing industry on a profitable basis and supply the kinds and qualities of cotton needed in making war materials is, therefore, a question of primary importance. Our own war requirements and needs of our Allies are becoming increasingly exacting. This means that producers of cotton must pay more attention than ever before to ways of increasing quality and the production of needed types.

(b) The United States annually imports between 300,000,000 and 400,000,000 pounds of abaca, sisal, and henequen, some 10,000,000 pounds of flax, and over 1,000,000 pounds of hemp, for use in manufacturing rope, marine cordage, binder twine, textile fabrics, and other materials. During the war these requirements have greatly increased, and normal sources of supply have been cut off. Most of the abaca and sisal have heretofore been imported from the Orient and East Africa, and the flax and hemp from Europe. The problem confronting the United States is thus one of establishing in this country, or elsewhere in the Western Hemisphere, adequate, dependable supplies of these essential plant fibers or of suitable substitutes.

General Plan: All cotton improvement and production work, involving both field and laboratory experiments, is cooperative with the State agricultural experiment stations of the Cotton Belt, which act as a group in conformity with a coordinated plan of procedure. Certain fibers research is cooperative with the Food Distribution Administration and the Bureau of Agricultural and Industrial Chemistry. Other cooperation is with the Bureau of Entomology and Plant Quarantine, the Extension Service, and agencies using cotton in making war materials.

With fibers other than cotton, cooperative field investigations are made when advisable in foreign countries. Work with fibers in this country is cooperative with State experiment stations and various Federal agencies and commercial interests. Work with tropical plants, such as abaca, is cooperative with countries of Central and South America and with plantations operated in those countries.

Examples of Progress and Current Program: The Bureau's research program on cotton and other fiber crops is going forward with only minor shifts, since its war contributions can in large part be made by applying results already obtained and by following up important leads already developed. In some cases, however, the men working on long-time projects with cotton are being shifted to work on other fibers that are badly needed at this time. Cooperation is maintained with the War Production Board and the Army and the Navy, and with several other bureaus and agencies of the Department such as the Commodity Credit Corporation, Agricultural Adjustment Agency, Office of Foreign Agricultural Relations, and the Food Distribution Administration, as well as with State and commercial agencies working on special war problems.

Cotton investigations: The war needs for cotton are quite different from civilian needs. More than 11,000 cotton items appear on the procurement lists of the Quartermaster Corps. Special qualities of cotton are needed for khaki and other service clothing, canvas, bagging, webbing, belts, straps, cord and twine, tire cord, barrage balloon cloth, man-carrying balloon cloth, life rafts, flotation gear, airplane covers, strong thread, substitutes for silk, and other essential war, industrial, and civilian textile uses.

Sea Island cotton. Sea Island is the longest, finest, and strongest cotton in the world and is required for many special uses. The war has emphasized the need for greater length in Sea Island strains, and two new strains developed in the breeding work are already in production. Others are being increased for production in the immediate future. At the beginning of the war our Navy was faced with the need of extra long Sea Island with staple 2" and longer of the kind produced in the past only in the British West Indies. Puerto Rican stocks produced in co-operation with this Bureau are now apparently meeting the immediate needs for balloon cloth for man-carrying balloons, but small plantings of 2" stock are being made in Florida and in Texas so that production can be increased in these if necessary. Some of the best strains bred in South Carolina and Florida are being tested in Puerto Rico to meet post-war needs.

Improved quality of American-Egyptian. One of the most urgent fiber needs that developed during the war was for increased production of American-Egyptian cotton in our southwestern States. Recently this Division developed a strain with superior fiber structure and strength which is being accepted by spinners as a substitute for Egyptian growths and is now in large-scale production. A new strain, Amsak, has also been increased, preliminary spinning tests having indicated that it is the equal of the best Egyptians. With the decrease of cotton acreage in Egypt in order to make more land available for producing food, it is possible that we shall need to produce a larger supply of these long fine cottons to meet war and civilian needs.

Extra-long staple upland cotton. The war increased the need for the longer lengths of upland cotton. Surveys of available seed stocks and close cooperation of the agencies responsible for increasing production gave a sufficient increase in acreage to meet the needs, but the demand will probably continue for several years. Every effort is being made to increase seed stocks of the better varieties of these staple lengths, and new strains of better quality which have been developed and are now being increased will be placed in production as soon as possible.

Better medium staple cotton. The large increase of our better medium staple cottons 1 to 1-1/8 inches in length under standardized production in one-variety communities is helping to supply the need of cotton of special character for particular war materials. Our researches have demonstrated that certain of the varieties now grown in these one-variety communities produce yarns from 15% to 20% stronger than those produced from other varieties of equal length. The demand for these stronger cottons of better character, particularly for tire cord, is intensified by war needs. There are now 2,563 one-variety communities operating in 575 counties in 17 cotton-producing States involving 7,613,533 acres and a production of 4,570,122 bales. Special war needs are being studied, and shifts of varieties in these communities are being planned so that there will be increased production of those most needed. Recently developed X-ray and laboratory techniques for measuring strength and other

fiber properties and improved spinning techniques are being used to determine the value of the varieties now in production and also of the new selections and strains which are being increased to go into war materials.

Fertilizer and cultural practices. Increased acreage of peanuts and soybeans in rotation with cotton in the South has intensified fertility problems of cotton. Old established fertilizer practices are obsolete. Cotton in rotation with these crops requires the use of more potash and less nitrogen than formerly. Lime is used generally on peanuts, and this renders unavailable some plant foods essential for cotton, which must be supplied for its successful growth. Studies on means of supplying nitrogen for cotton by winter cover crops and summer legumes indicate that these practices aid in conserving commercial nitrogen. Experimental work has shown that reduced dosages of organic materials from those formerly used for seed treatment will give protection against certain seedling diseases. The use of these organic materials is conserving critical mercury. Experiments and demonstrations are being expanded to give additional information for meeting cotton fertility and cultural problems during and after the war.

Oil and protein in cotton seed. The abundant supply of oil and protein for food and feed during the past had resulted in relatively little emphasis being placed upon the composition of cotton seed. With the advent of war and the consequent scarcity of both oil and protein, greater emphasis has been placed on work designed to increase the supply of these. Factors influencing oil and protein content and the effect of storage on the qualities of these are being studied. It is found that the composition of seed of different varieties of cotton varies to a considerable extent. The proportion of oil and protein also varies with the climatic and fertility conditions under which the cotton is grown. Adequate potash in the fertilizer increases oil production on some soils. Varieties containing a larger percentage of oil with little change in protein are now in prospect. Studies of the factors which cause deterioration of seed in storage are resulting in increased output of oil and an improvement in its quality.

Rot and mildewproofing cotton fabrics. Fabrics used in humid tropical countries mildew and rot very readily. Before the war, this Bureau had conducted studies of the deterioration of cotton in the field, in storage, and in fabrics and had developed laboratory techniques for studying organisms and other agents of decay. When the Quartermaster Corps and the Army and Navy engineers were confronted with the need for making rapid tests of burlap, clothing, and other materials for use in tropical countries, they requested the aid of our scientists working in this field. Intensive researches on test procedure and on preservative treatments have resulted in rapid laboratory tests which reveal in from 7 to 10 days the effectiveness of different commercial treatments designed to prevent mildew and decay. The service tests procedure formerly employed required months and in some cases years to complete. We have determined that copper naphthenate prevents rotting of cotton fabrics at lower

concentrations than any of the other copper compounds studied. This work has been expanded in cooperation with other agencies of the Department, the Army and Navy, and with manufacturers of chemicals and processors who are making various articles for war use.

Fiber plants other than cotton: Seven of the plant fibers other than cotton, including abaca, sisal, henequen, flax, hemp, jute, and kapok, are now either strategic or critical raw materials. With the exception of henequen, flax, and hemp, our supplies of these fibers have been obtained mainly from the Far East. Some of the sources of supply have been entirely eliminated, and others are now seriously threatened. An adequate supply of these fibers is essential to the continued production of many different materials used in military operations, and existing stocks are being rapidly exhausted.

The increased production of these fibers, or of acceptable substitutes, either in the United States or in other countries of the Western Hemisphere, has become a vitally important war problem. The fiber specialists of the Department have been in constant touch with the different war agencies of the Government, and in addition to the work conducted within the Department, have assisted these agencies in formulating other fiber programs. Scientists have been temporarily assigned from other investigations to work on these special fiber problems.

Abaca. One of the most critical fiber problems is that relating to future supplies of abaca. This fiber furnishes material for the manufacture of marine cordage and other high-grade rope. Our entire supply of this fiber has heretofore been obtained from the Orient, principally from the Philippine Islands. Fortunately, the Department had introduced this plant into the American Tropics and an abundant supply of planting material is now available. Arrangements were made with an American plantation company for the development of a large abaca project in Panama, Costa Rica, Guatemala, and Honduras. Plantings to July 1, 1943, totaled 22,887 acres and the program involves planting an additional 15,000 to 18,000 acres. More than 2,000,000 pounds of abaca fiber from these plantings had been delivered in this country on July 1, 1943, and about 3,000,000 pounds of this fiber had been produced by November 1. It is expected that the production will exceed 1,000,000 pounds per month when fiber cleaning equipment is installed on all of the plantations.

Hemp. American hemp, produced by the plant *Cannabis sativa*, is considered to be the most satisfactory substitute for abaca in the manufacture of marine cordage. The War Production Board, recognizing the seriousness of the cordage fiber situation early in 1942, instructed the Secretary of Agriculture to arrange for growing some 30,000 acres of hemp to provide seed for an enlarged future hemp fiber program. This project was successfully carried out. Due to lack of seed, it was not possible to attain the 300,000 acres of hemp for fiber planned for 1943, but approximately 185,000 acres for fiber and 40,000 acres for seed were planted in 1943. This Bureau supplied information on growing and handling this

material in the field. During 1942 and 1943 test plantings were conducted to locate the areas best suited for this large acreage, and these will be continued and enlarged to determine areas for further expansion in line with War Production Board instructions. Since this program must be carried out by growers unfamiliar with the crop, and in areas where hemp has not been grown to any great extent, much intensive investigational work must be done quickly, and its results must be made promptly available to growers. We have demonstrated that seed treatment with organic dusts protects the crop from soil-borne and seed-borne disease organisms, with the result that the entire crop planted in 1943 was so treated. Our specialists assisted in establishing hemp fiber and hemp straw grades used in purchasing hemp under the government war hemp program, and tested and calibrated moisture-testing machines which were adopted for use in purchasing straw hemp from farmers on a definite moisture-content basis. The Bureau is cooperating closely in supplying information and technical assistance to the Commodity Credit Corporation, the Agricultural Adjustment Agency, and the Extension Service, charged with the action program.

Sisal and henequen. These fibers furnish the raw material for binder twine and many other types of cordage, and are not produced in the continental United States. With respect to the increased production of these fibers, the Department has cooperated with other agencies that are directly concerned with fiber production in the Latin American countries. New plantings of sisal have been made in Haiti, and improvements are being made on the henequen plantations of Mexico.

Yucca fiber. In the southwestern States there are large areas of wild yucca plants, the leaves of which contain fiber. As there is a possibility that this fiber can be produced in commercial quantities, work on this problem was undertaken and is being continued.

Sansevieria. This plant grows wild in Florida and is also cultivated there as an ornamental. It produces a fiber which can be used in the manufacture of cordage of a type for which there is urgent need. In view of the fiber possibilities of this plant from a war standpoint, experimental work is being undertaken in Florida at the suggestion of the War Production Board to determine the conditions of production, the relative value of different species, and other factors involved. Sansevieria grows rapidly, and encouraging results already are being obtained.

Fiber flax. An increased acreage is being planted to fiber flax in Oregon, and both Peru and Canada will be able to furnish supplies of this fiber. The Department work is now concentrated on the development of increased production in the United States, and on cooperative work with agencies concerned with the production of fiber flax in other American countries.

Jute and kapok. While we are growing jute successfully on an experimental scale, commercial production appears to be impracticable in the continental

United States, but there are several substitutes that might possibly be produced in this country. These include Crotalaria, Hibiscus and Urena lobata. Roselle (Hibiscus sabdariffa) and sunn hemp (Crotalaria juncea) produce yields in Alabama and Texas comparable with those secured in India and other countries where these fibers are grown. Experimental plantings of these plants have been made in the southern States. The development of the production of kapok, or of substitutes for this fiber, is being encouraged by cooperative work with war agencies, and milk weed floss is being studied as a possible substitute for kapok. We have determined the relative buoyancy of kapok, cat-tail, milkweed, cotton and other flosses and studied their probable value for flotation purposes, finding that cotton when treated with wax appears promising as a substitute for kapok for these purposes.

Loofahs (vegetable sponges). To meet military needs, the Bureau has co-operated with the Navy Department and commercial organizations in the production in the United States and in Latin American countries of loofahs, or vegetable sponges, to replace the supplies formerly imported from Japan for certain critical naval uses. Experimental plantings made in 1942 in a number of southern States from North Carolina to California met with varying degrees of success and these are being repeated and the problems studied.

(f) Drug and Related Plants

Appropriation Act, 1944	\$62,250
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+7,941
Total anticipated available, 1944	70,191
Budget estimate, 1945	70,308
Increase	+117

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Drug, oil, insecticide, tannin, flavoring and re- lated plant investigations	\$54,365	\$58,965	\$59,082	+\$117 (1)
2. Hop production, breeding, disease, and quality in- vestigations	10,945	11,226	11,226	- -
Covered into Treasury in ac- cordance with Public Law 674	360	- -	- -	- -
Unobligated balance	220	- -	- -	- -
Total available	65,890	70,191	70,308	+117
Anticipated deficiency for overtime pay	- -	-7,941	- -	-
Total estimate or appropriation	65,890	62,250	70,308	

INCREASE

(1) An increase of \$117 in this item for 1945 for overtime pay is required under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	\$3,870:	- -:	- -
Additional funds for overtime (appropriated,:	:	:	:
1943, estimated supplemental, 1944; and :	:	:	:
included in budget estimate, 1945)	- -:	\$7,941:	\$8,058
Total cost of overtime (7 months in	:	:	:
1943)	3,870:	7,941:	8,058

WORK UNDER THIS APPROPRIATION

Objective: As a means of insuring supplies of certain critical drug, insecticide, tannin, paint and varnish oils, condiment, and related plant products, (a) to determine the regions with suitable soil and climatic conditions for production of such crops; (b) to determine and supply as far as practical, information useful and necessary for the utilization of native plants and for the introduction and maintenance in the United States of a commercial production of plants that furnish the raw materials for these commodities needed in the war effort; and (c) to maintain stocks necessary for the development of varieties of hops resistant to downy mildew and other diseases, and that produce higher yields of superior quality hops and to determine non-critical materials necessary for hop production and non-critical spray and dusting materials effective in controlling downy mildew of hops to increase production for domestic consumption and to replace supplies of a high quality formerly imported.

The Problem and its Significance: In the past the industries in the United States which manufacture medicines, insecticides, leather, flavoring extracts, paints, varnishes, linoleum, perfumes, and related products, have been dependent to a very large degree on foreign sources for the plant materials that go into such manufactured articles. With the present disruption of world trade their procurement is now greatly limited and entirely impossible for many materials. Many of the plants from which the desired materials may be obtained have been introduced into the United States and found to be adapted to growing conditions in certain sections of the country, and some native plants are potential sources for the production of these critical materials. However, the culture and production requirements of this group of plants are not well known, and often are entirely unknown.

The quality of most crude drugs and related products is affected by practices in growing, harvesting, curing, baling, and storing the crop.

It is necessary, therefore, to determine the degree and importance of these relationships in order to guide growers, most of whom are not familiar with these crops. To insure adequate supplies and to protect interested growers, it is important to determine the areas for most satisfactory production and encourage production only in these areas because of the relatively small volume of each material needed.

Drug plant materials are collected from widely diverse parts of the world and vary greatly in quality. Adequate information on growing drug and related plants in this country can insure reasonable profit to growers and supply a more dependable source of raw materials of better and more uniform quality, necessary for many drugs. Although such new crops need to be expanded only on a limited scale, they are important from the standpoint of providing our needs of critical materials.

The American hop crop had a pre-war market value of over \$10,000,000 annually and has a current market value of about 5 or 6 times that amount. In the past, 6 to 8 million pounds of European hops which are claimed to be superior have been imported annually. These latter sources of supply are now cut off and it is necessary to increase the amount as well as the quality of the domestic hop crop if usual market demands are to be supplied. There is increasing competition among domestic buyers now in an attempt to secure high quality seedless hops of domestic production which are now replacing such materials formerly imported from Europe. If the domestic crop can be improved further through introduction or development of new varieties that are not only disease resistant but compare in quality with the preferred European type, domestic production can be increased by the amount of these imports.

In the control of hop diseases certain materials used in sprays and dusts are on the list of critical war materials, and others are impossible to obtain. It is now necessary to ascertain what substitute materials are available that will satisfactorily prevent and control disease. It is also important to determine substitution for critical materials such as burlap and others which are needed for the production of hops.

General Plan: The work involves four distinct phases: (a) A critical review of experimental work conducted in the past on such specialized crops as are now needed in the war effort in order to determine the regions most suitable for immediate domestic production; (b) field guidance and further work on the immediate production problems pertaining to propagation, culture, harvesting, curing, distillation and other processes, yields, and production expenses; (c) laboratory examination of materials to determine their quality and the relation of various conditions and practices to quality; and (d) development of varieties and types of superior quality and greater disease resistance. Since many species are involved, with possible adaptation to a wide range of conditions, the field work must be done in numerous locations throughout the United States. Most of the laboratory work and some field work is conducted at Beltsville, Maryland; however, most of the cultural, selection, and breeding work is conducted at field stations of the Bureau and through cooperation with the various experiment stations. Cooperation with growers is maintained

for guidance and for solutions of new problems as they arise in the production of a new crop.

The investigation of hop disease problems, field control measures, and the breeding work are centered at Corvallis, Oregon, and conducted in cooperation with the Oregon Agricultural Experiment Station, with close cooperation with growers and county agents elsewhere in the State and in California and Washington. Three experimental hop yards totaling 7 acres are maintained for this purpose, and greenhouse and laboratory studies are conducted in connection with the field work. Laboratory analyses for quality determinations are made at Beltsville.

Examples of Progress and Current Program:

Drug, oil, insecticide, tannin, flavoring, and related plant investigations:

Increase in demands for civilian and military supplies and cutting off of supplies of essential drug, oil, and insecticide materials heretofore imported have necessitated a shift in the work under this appropriation to meet the emergency. Based on results of previous experimental work, immediate determination has been made of areas where these crops can be grown, seed supplies have been built up, and information accumulated as rapidly as possible on culture and other practices necessary for the successful production of these specialized crops. Technical services and guidance as needed are being given to growers in order to assure products of suitable quality and in sufficient quantities to meet the critical need. There is a tendency toward not producing some critical items, or overproducing or overplanting others because they are new and have public interest, and the Bureau's guidance has thus provided a balance wheel for both domestic production and production in other countries of this Hemisphere. In response to requests, a great amount of technical assistance has been given to the Office of Foreign Agricultural Relations, the War Production Board, and the Foreign Economic Administration.

Morphine. A cooperative program with the Bureau of Narcotics has been continued with some modifications. Areas in the United States have been determined where opium poppies can be grown successfully either as a summer or winter crop; and methods of growing and handling the crop and controlling certain diseases have been developed sufficiently to meet emergency needs. Varieties yielding satisfactory amounts of morphine have been selected, and seed of these varieties is being increased in test plots of considerable size in order to determine more effective control practices. Seed of these selected varieties sufficient to plant several thousand acres to supply our needs has been produced and is being held for use in case of an emergency. This work has progressed to the point that it now seems desirable to lay stress on further selection and improvement of the varieties in the few regions that, during the relatively short period of testing, have appeared to be best adapted.

Belladonna and Henbane. The acreage of belladonna and henbane planted in 1942 from seed produced in the Bureau has yielded supplies adequate for

the military and domestic needs of the country. A much smaller acreage of belladonna was planted in 1943. Disease problems have, however, become much more critical, and it is possible that an increased production may be necessary in 1944. Technical experiments to improve quality, yields, and to control diseases are under way, and further work has been carried on to determine regions where these crops can be most economically produced. New methods of handling these crops in this country have been developed independent of methods used in countries where these materials have ordinarily been obtained. On the whole the quality of these drug-plant products is far superior to materials formerly imported. This progress is largely due to better methods of culture, more efficient preparation of the crude drug, and use of improved strains.

Drying oil plants. Dehydrated castor oil is the most practical substitute for tung oil so essential for naval and military use, but no longer available from the Orient. For the third year, test plantings of the more promising varieties of castor beans in 17 States have shown areas and varieties best suited for domestic production. Plantings from the two previous years have indicated the region of most promise, and in 1943 the research program was revised to give more technical information with regard to the behavior of the varieties in the specific localities where they seemed to be adapted. A program is also under way to develop more satisfactory varieties and determine effective means of disease control. The Agricultural Adjustment Agency, the Commodity Credit Corporation, and this Bureau have cooperated in a program for 1943 plantings of the improved varieties to provide seed for a production program if needed in 1944. Approximately 6,000 acres were harvested in 1943. The castor bean hullers have been improved, and modification was made on a sufficient number of these machines to hull the 1943 crop. A part of the seed developed in the 1942 increase program has been utilized for planting in other countries of this Hemisphere. This seed is of a variety that now appears to be the only one available with sufficient uniformity to make it adapted to mechanical hulling.

Other drying-oil crops such as safflower and perilla are being tested in regions where they have given most promise. Their production will be encouraged where circumstances warrant.

Insecticide plants. Since the expansion of military campaigns in mosquito-infested countries and with the increased use of pyrethrum in the control of lice and mosquitoes, there has been a need for domestic production or production in this Hemisphere to augment available supplies. At the request of the former Office for Agricultural War Relations and other cooperating Government agencies, all available seed of pyrethrum has been collected from experimental plantings and is now being released for an increased acreage in this Hemisphere. In developing the pyrethrum production program cooperating agencies have depended upon this Bureau for technical information.

The greatly increased demand by agriculture for insecticide materials makes it necessary to expand the production of any plants which may be used as insecticides. Enlarged tests are being conducted to work out economical practices necessary for any rapid increase in the domestic production of devil's shoestring, for example, as a source of rotenone for agricultural insecticides. A cooperative planting with the Texas Agricultural Experiment Station has been made to increase available stock of the better yielding strains. Some of this material, together with other material obtained from plants growing wild, has been collected and is now being tested by commercial concerns to determine the feasibility of large-scale processing. Work is in progress to develop and increase superior strains with high rotenone content. A few plants yielding a relatively high amount of rotenone have been developed; however, the problem is extremely complicated from the standpoint of breeding.

Tannin plants. With the increased demand for leather products for both civilian and military needs, it has become necessary to utilize as many native plants as possible for domestic sources of tannin. An extensive cooperative program involving the Soil Conservation Service, the Bureau of Agricultural and Industrial Chemistry, and this Bureau is now under way to give technical assistance in the utilization of domestic sumac. Technical assistance in methods of harvesting, drying, and locating stands with a suitable tannin content has been given. Work is in progress to develop and increase superior strains, and a planting of considerable size to increase stocks has been made. It will be necessary to increase these stocks for several generations before sufficient material will be available for distribution.

Extensive tests in field processing of a canaigre grown in field plots and collected from plants growing wild in southwestern United States were carried on during the past year, and very satisfactory results have been obtained. A method of shredding and drying canaigre on location has been developed. The material prepared is now available for chemical and pilot tests in a cooperative program with the Bureau of Agricultural and Industrial Chemistry and commercial tanning concerns.

Hop investigations: With the increased demand for domestic hops to provide a supply of materials formerly imported, in addition to our usual needs, the control of diseases is becoming of greater significance. Because of the limitation of certain critical spray and dusting materials it has been necessary to develop available substitutes, and recommendations based on experimental tests have been made to growers in sufficient time to give fair protection to the 1943 crop. Copper spray and dust materials are unobtainable or available only in limited supply. Formulas using zinc sulfate, which is available, are used with a resin-potash spreader developed by the Bureau and are proving quite satisfactory. The work of the Bureau in developing and encouraging seedless hop production appears most timely in producing the superior quality of hops now being accepted in lieu of such materials formerly imported.

(g) Dry-land Agriculture

Appropriation Act, 1944	\$230,563
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+27,000
Total anticipated available, 1944	257,563
Budget estimate, 1945	245,000
Decrease	<u>-12,563</u>

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. Dry-land agriculture investigations:				
(a) Dry-land crop pro- duction investigations	\$199,558:	\$226,923:	\$214,360:	-\$12,563 (1)
(b) Cooperative farm wind- break demonstrations and experimental test plantings	30,237:	30,640:	30,640:	- -
Covered into Treasury in accordance with Public Law 674	225:	- -	- -	- -
Unobligated balance	4,768:	- -	- -	- -
Total available	<u>234,788:</u>	<u>257,563:</u>	<u>245,000:</u>	<u>-12,563</u>
Anticipated deficiency for overtime pay	- -	-27,000:	- -	
Total estimate or appropriation	<u>234,788:</u>	<u>230,563:</u>	<u>245,000:</u>	

DECREASE

- (1) The reduction of \$12,563 contemplates discontinuance of the U. S. Dry-land Field Station at Lawton, Oklahoma, and discontinuing cooperative work at the State Branch Station, Moro, Oregon.

The work at Lawton includes improved methods of tillage and crop rotation for the subhumid region of southwestern Oklahoma, and cooperative tests on chinch-bug resistant sorghum varieties and on improved varieties of cotton and wheat and other cereals. The cooperative work at Moro is primarily on improved methods of tillage and crop rotation for most efficient production of wheat and other cereals under dry-land conditions in the Columbia Basin.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	:\$15,404:	\$9,395:	\$9,395
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	:	:	:
	4,000:	27,000:	25,377
Total cost of overtime (7 months in 1943) ;	19,404:	36,395:	34,772

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: The broad objective of this work is to aid in developing a more stable agriculture under dry farming conditions in the Great Plains and in other semiarid regions. Specific objectives are to (a) improve cultural and rotation practices that will make possible the most efficient use of limited rainfall on different soil types for cash-crop and livestock production; (b) develop methods and materials for successfully growing farm windbreak and fruit and vegetable gardens; (c) increase and distribute seed of improved and special-purpose crop varieties; (d) test and give advice on new crops for supplying war needs; and (e) use every facility in aiding farmers to produce to the maximum with restricted labor and materials.

The Problem and its Significance: About one-fifth of the land area of the United States lies in semiarid regions where light rainfall is the major factor limiting crop production. Except in a few scattered irrigated areas within this vast region, crops are produced successfully only by cultural methods that store rainfall in the soil and promote its efficient use by plants. Farm practices, therefore, must be carefully adapted to an erratic climate and to varied soil conditions. Not only the cultural methods but also the crops must be peculiarly adapted to such conditions in order to insure a stable agriculture.

In the Great Plains alone, dry farming is practiced on nearly half a million farms aggregating 107,000,000 acres of crop land. These farms comprise over half of America's total wheat acreage, three-fourths of the hard-red winter and spring wheat acreage, and large parts of the acreage devoted to flax, barley, oats, rye, corn, and cotton production. On many of these farms, pioneering practices have given way, or are giving way, to more mature practices, based upon the results of experience and experiment during the last forty or more years. With better information as to the true possibilities of soil and climate there is now developing a pattern upon which to base a permanent successful agriculture for the area. Better understanding of the Plains environment, more widespread use of improved methods of soil management to store water, control erosion, and meet crop requirements, adjustments in cropping methods, and the use of improved varieties to meet drought, disease, insect and other hazards--all these factors are discernible in the progressive improvement of agriculture in the Great Plains and other semiarid regions.

There is a generally recognized need for additional factual information on cropping methods, crop rotations, grass establishment and utilization, home gardens, windbreaks, and general land-use adjustments to maintain present trends toward improved dry-land agriculture. This is particularly true in view of the task farmers now confront in meeting the problems re-

sultant from earlier land policies that were conducive to exploitation, misuse, confusing ownership patterns, and inequitable taxation; as well as the more recent consequences of wartime disturbances affecting all phases of agricultural activity.

Since its beginning the work under this appropriation has been directed to the determination of best methods of utilizing the natural soil and climatic resources of the semiarid and subhumid areas of the country. Adjustments in work made to meet problems arising from the climatic and economic stresses of the past decade, when only the most efficient methods made survival and continuation possible, have in fact been so made that without major changes the now pressing war needs are being successfully met. The experimental results from the field stations are furnishing a background of facts of great value in guiding agricultural programs and fostering food and feed production at highest possible levels during the war, and in indicating readjustments that inevitably will follow the war.

General Plan: The investigations are conducted, generally in cooperation with the State experiment stations or with other agencies of the Department, at (a) field stations maintained by this Bureau at Akron, Colorado; Tucumcari, New Mexico; Mandan, North Dakota; Lawton and Woodward, Oklahoma; Big Spring and Dalhart, Texas; and Sheridan, Wyoming; (b) field stations maintained by the Bureau's Division of Irrigation Agriculture at Huntley, Montana, and Newell, South Dakota; and (c) state substations at Colby, Garden City, and Hays, Kansas; Havre and Moccasin, Montana; North Platte, Nebraska; Dickinson, North Dakota; Pendleton and Moro, Oregon; and Archer, Wyoming. At these stations facilities are provided, not only for the research work of the Bureau's Division of Dry-Land Agriculture, but also for work which is cooperative with various other divisions of the Bureau, such as Cereal Crops and Diseases and Forage Crops and Diseases; with other agencies of the Department, such as the Soil Conservation Service; and with the State agricultural experiment stations of the several States. These stations provide the principal agricultural research facilities for this vast region of one-fifth of the United States.

Examples of Progress and Current Program: The 10 Federally operated field stations in the Great Plains and the 10 State substations at which cooperative work is conducted serve as centers for developing cropping and rotation systems for the dry-land areas, and for testing, breeding, and distributing new and improved crop varieties. These stations also are foundation sources of pure seed.

Many experiments on field stations involve problems of soil changes and modifications under different treatments and cropping systems, and are necessarily of long-time nature. These have been continued, but other phases of work have been modified, shifts in emphasis have been made, and problems of immediate concern under stress of wartime needs have been given increased attention. Changes in rotation experiments to include more feeds and roughages grown on the farm and cultivated pastures to supplement the native range are showing the way to increased livestock production combined with maximum crop production, adequate protection to the soil, and continuity of farming in dry-land areas.

In meeting the program for a greatly increased acreage of wheat for harvest in 1945, farmers throughout the dry-land areas will be largely guided and protected by the results of research showing that the highly probable success or failure of a prospective planting is dependent on the quantity of water stored in the soil.

In northwestern Kansas, for example, winter wheat supported by the water stored in summer-fallowed land has averaged from 30 to 40 bushels to the acre in 1943, but wheat on cropped land has averaged between 5 and 10 bushels with many fields not worth harvesting. In northeastern New Mexico a large acreage of wheat on summer-fallowed land survived an unprecedented drought from mid-October until well into June and produced creditable yields.

Tillage implements. Attention has been given to newer implements and methods of cultivation. Results from basin listing as a means of increasing yields continue to be disappointing, but implements that leave many small basins to check run-off show to advantage. Particularly promising results have been obtained both on cultivated land and on native sod with the eccentric oneway, which was developed at a dry-land field station. The first results of intensive experiments to determine the value of subsurface or trashy cultivation indicate that the protection it affords against soil erosion may be attained at most locations in the Great Plains without sacrifice of yield.

Special wartime crops. Tests of crops of special value to the wartime economy have not revealed any new ones of sufficient promise to warrant extension of acreage without further trials. The acreage of flax, dry beans, and peanuts can be increased to advantage in dry-land areas in which investigations at field stations have shown they are respectively adapted. Stations in the central and southern Plains are testing guayule to determine the possible limits of its growth. At Woodward, Oklahoma, 25 strains are under trial to determine their relative resistance to cold.

Seed increase and distribution. The field stations serve as propagation and distribution centers of seed of new and improved crop varieties. Among the seeds distributed in substantial quantities or being grown for distribution may be mentioned Wheatland milo resistant to root rot, Beaver milo, Sedan kafir, Collier sorghum, Cheyenne wheat, Yogo wheat, and Ward and Woodwin winter barleys. Cooperative investigations at Lawton, Oklahoma, where chinch bug damage usually is high, have shown the possibility of reducing or avoiding such damage to sorghums by planting resistant varieties early in seedbeds that give prompt emergence.

Grass and pasture investigations. Methods have been developed by which a high degree of success is attained in seeding grasses on abandoned or uncultivated land, and in planned year by year seedings in crop rotations. These methods are being put into use by farmers on an increasing scale, and they have been of great value in seeding airports, airport runways, and other army and emergency posts, depots, and developments.

Experiments with crested wheatgrass, which was introduced through dry-land stations, have shown its value as pasture for cattle and sheep and the best methods of utilizing it in the pasture program. Winter feeding trials in Montana have shown crested wheatgrass hay cut before bloom to be superior to native grass hay or crested wheatgrass cut after bloom. It has been shown that Russian wild rye is a valuable pasture grass in the northern Great Plains. The feasibility of using early-cut cereal hays as high protein feeds for livestock has been demonstrated.

The grazing unit at Woodward, Oklahoma, was pastured according to schedule, and 225 acres of abandoned land were seeded to different grasses for pasture tests. Experiments in the control of sagebrush in pastures have shown nearly complete eradication of the sagebrush and a great increase in the grazing capacity by mowing in June in two successive years.

Nine strains of grasses in the grass breeding work at Mandan, North Dakota, in cooperation with the Division of Forage Crops and Diseases and the Soil Conservation Service, are of such promise that they have been selected for increase.

Fruit and vegetables. The continued testing of tree, bush, and vine fruits to determine the old, new, and introduced varieties adapted to conditions of soil and climate in different parts of the Plains is producing outstanding results with apples, crabs, plums, grapes, currants, gooseberries, and raspberries. Grapes are the best adapted fruit in the southern Great Plains, but in many sections their growth is limited by chlorosis. Methods of control by applying iron sulphate to the soil have been worked out.

Fruit breeding work has provided new apples, crabs, plums, currants, and other tree and bush fruits for wider testing and distribution. Tomato breeding has produced superior varieties for both the northern and the southern Plains.

The results of variety and cultural experiments that have been conducted with vegetables have been of particularly timely importance in guiding and assisting growers of Victory gardens, many of whom were inexperienced gardeners.

Trees for windbreaks. Experiments at field stations and in cooperation with farmers are showing that close planting of trees for dry-land windbreaks results in suppression, poor height and diameter growth, and weak and shortlived trees. Spacing distances of 15 feet between rows and 8 feet or more in the row are now recommended. Tests of several hundred varieties of trees and shrubs have proved a limited number of deciduous and coniferous species to be of outstanding value for general use. With some species the greatest degree of success may be dependent on the selection and propagation of a type within the species. The problem of the longevity of windbreaks on the high Plains is still unanswered, but in some local areas it appears probable that they will be relatively

short-lived and that plans for replacement should be a part of the general planting plan. In the southern Plains the principal value of windbreaks is to serve as partial barriers to high winds and to protect against hot winds in summer, but in the northern Plains an important function is in increasing the water supply of limited areas by the accumulation of snow drifts. Such snow drifts greatly increase the water available to the trees and to gardens or other plantings.

(h) Forage Crops and Diseases

Appropriation Act, 1944	\$292,000
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+35,837
Total anticipated available, 1944	327,837
Budget estimate, 1945	<u>327,837</u>

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. Forage crop production, breeding, disease, and quality investigations:				
(a) Alfalfa	\$ 58,661:	\$ 63,950:	\$ 63,950:	--
(b) Clover	25,364:	29,090:	29,090:	--
(c) Soybeans	16,941:	19,137:	19,137:	--
(d) Lespedeza, cowpeas, and miscellaneous le- gumes	34,460:	38,990:	38,990:	--
(e) Hay and pasture grasses	147,722:	168,570:	168,570:	--
(f) Turf	44,212:	8,100:	8,100:	--
Covered into Treasury in ac- cordance with Public Law 674	1,130:	--	--	--
Unobligated balance	30,010:	--	--	--
Total available	<u>358,500:</u>	<u>327,837:</u>	<u>327,837:</u>	--
Anticipated deficiency for overtime pay	--	-35,837:	--	
		-190-		
Total estimate or ap- propriation	<u>358,500:</u>	<u>292,000:</u>	<u>327,837:</u>	

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$21,134:	\$6,079:	\$6,140
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	--	35,837:	35,837
Total cost of overtime (7 months in 1943)	<u>21,134:</u>	<u>41,916:</u>	<u>41,977</u>

WORK UNDER THIS APPROPRIATION

Objective: Special emphasis is being placed on those lines of work that offer the greatest contribution towards increased production of forage and seed to meet wartime demands for increased supplies of meat, dairy products, and wool, and towards increased production of soybeans and other critical crops. These objectives are realized by (a) reducing losses from drought, disease, cold, heat, and other hazards; (b) increasing the yields of forage and seed; (c) improving the value of the forage for livestock feed; and (d) promoting and facilitating a greater use of legumes for winter cover crops.

The Problem and its Significance: Grasses and legumes, the most important feed and soil-conserving crops, are grown on more than 600 million acres in this country, or on about half of the total farm area of the United States. A conservative estimate of the total annual farm value of all forage crops would be upwards of \$1,500,000,000.

To meet the greatly increased demands for meat and dairy products and wool resulting from the war effort, it is essential to increase yields of forage crops through modification and improvement in cultural and management practices under existing shortages of labor and machinery and inadequate supplies of fertilizers, and through the development and use of better adapted varieties having greater resistance to cold, drought, and diseases. Increased production of forage seeds is needed to meet domestic and Lend-Lease requirements.

General Plan: The work consists primarily of field, greenhouse, and laboratory experiments in cooperation with State agricultural experiment stations, Federal agencies, farmers, various crop improvement associations, and other similar groups. Cooperative work is in progress in each of the 48 States, with full-time employees located in 22 States. Results are made available to farmers through the State experiment stations and extension services and by publications. During the war emergency, emphasis is being placed on making available to farmers information on how to maintain production and at the same time modify practices so as to offset wartime shortages of seeds, labor and equipment, and insure more efficient use of fertilizers. Emphasis is likewise being placed on increasing as rapidly as possible the seed supplies of new, improved types of forage crops for use during the emergency, and on the production of seed supplies of standard varieties to meet current needs at home and abroad. Efforts are being made to assist in establishing and maintaining turf for camouflage and intensive use on military airports, cantonments, and other problem areas and to develop strains of grasses for special heavy uses. Under present emergency conditions, considerable time is devoted to advising and assisting different agencies on problems of feed production, seed goals, fertilizer requirements, etc., as they relate to various phases of the national nutritional and food production programs. The forage crop scientists are also rendering assistance in the establishment and maintenance of turf on military airports, cantonments, and other vital areas.

Examples of Progress and Current Program:

Forage crop production, breeding, disease, and quality investigations:

Alfalfa. Alfalfa, one of the leading cultivated forage crops, with 16 million acres grown in 1942, has been difficult to maintain in adequate production because of diseases and insects and increasing war needs for forage for livestock. Emphasis has thus been placed on making available to farmers information on cultural practices that will insure greater yields and help meet these increasing demands, including those for seed and for current planting stock. Means of improving quality are likewise receiving attention.

Progress has also been made in developing improved disease-resistant varieties that are regionally adapted, and one of these, Ranger, adapted to the northern region, has been released for commercial use. A second new wilt-resistant variety, Buffalo, adapted to the central area, will be released to growers for 1944. Seed stocks are being increased as rapidly as possible. Increased production has followed the use of selected wilt-resistant strains, and efforts are being made through proper cultural practices to maintain stands and extend the life period of established plantings.

Clover. Clovers are of basic importance to food production in supplying hay and pasture for the increased number of dairy and meat-producing animals. Throughout the Corn Belt, clovers are the most widely used in legumes for soil improvement. With the war need for increased food and feed crops, the clovers supply organic matter vital in maintaining production of soil-depleting crops. More effort is being given to increasing seed production of the disease resistant high yielding red clover varieties, Cumberland and Midland, since the use of common seed leads to a wasteful use of labor, fertilizers, and land. The seed of two newly developed strains is being increased for testing purposes to determine their possibilities. Important new varieties of sweetclovers include Madrid, a superior biennial yellow for the Great Plains; Spanish, a high yielding biennial white; and Evergreen, a late type. Progress is being made in developing varieties to combat diseases and to improve the quality of hay. The studies with these new strains involve the determination of regions where they are best adapted; methods of producing the most seed possible per unit area; and the protection of seed stocks to avoid contamination with inferior strains. Lend-lease requests for seed of red, alsike, and white clovers have increased from 6,000,000 pounds in 1942 to approximately 8,000,000 pounds in 1943. With legumes seed shortages brought about by an increased acreage of row crops, cultural methods to use available clover seed supplies more efficiently are being stressed. The adaptation of different clovers in pastures is being studied to increase the quantity and quality of herbage.

Soybeans. Consumer-rationing of food, fats, and oils, and increased demand for high-protein feeds essential for the country's need for more

live-stock emphasize the value and importance of the soybean in the present national emergency. The 1944 goal for soybeans has been placed at 13,654,000 acres, 19% more than the record acreage in 1943. Although a large percentage of soybean oil is used in shortening, margarine, and salad oils, considerable quantities are used in the manufacture of enamels, paints, varnishes, rubber substitute, printing ink, oil cloth, and core binder. The oil meal is utilized largely for cattle feeds, but it is being increasingly used in making flour, grits, and flakes, all of which are now being used extensively as a valuable source of protein by our civilian population, the Army, and our Allies. Other products of an essential nature made from the bean meal are glue, fiber, and plastics.

The production of seed for commercial purposes has become a well-established industry, chiefly in the North Central States, increasing from 5 million bushels in 1925 to over 200 million bushels in 1942. More than 100 mills are now engaged in the processing of soybeans for oil, meal, flour, flakes, and grits, with as many more manufacturing various food products from the beans, flour, grits, and flakes. To meet the demands for adapted varieties of superior quality in the war emergency program, investigations have been carried on in cooperation with the Special Research Fund Regional Soybean Laboratory and State experiment stations in the North Central States, and during the present year have been expanded into twelve southern states. Several high seed-yielding, yellow-seeded varieties of high oil content have been released, principally in areas where there has been an acute need for varieties suitable for industrial purposes. These strains--Boone, Chief, Gibson, Patoka, Richland, Magnolia, Arkan, Arksoy, and Lincoln--are rapidly replacing some of the old standard types. Extensive tests with Lincoln indicate an outstanding variety in seed yield, percent and quality of oil, with a potential acreage of 5,000,000.

Although more seed of a greater number of vegetable varieties of soybeans were handled by a larger number of seedsmen and growers in 1942, seed supplies were exhausted before the end of the planting season. Green vegetable soybeans will be canned in large quantities the coming season, many of the large firms doubling their acreage. The dry beans are being sold in packages in many localities.

The record increases of soybean acreage and production during the past two years have greatly emphasized the disease problem, especially in the heavy-producing areas. Methods of control and the development of strains highly resistant or immune to the most serious diseases--leafspots, pod and stem blights, and root rots--are badly needed, and work is in progress on these problems.

Lespedeza, cowpeas, and miscellaneous legumes. Legumes occupy a very important place in the agriculture of the United States, particularly in the South. Lespedeza in cultivation and in pasture covers about 40 million acres, while cowpeas, velvet beans, burclover, and other legumes occupy ten or more million. In the present war emergency, these crops

are sources of highly nutritious forage demanded by the increased goals for meat and dairy products to supply our Army and Navy and our Allies. Lespedeza is a particularly valuable pasture plant, and it is generally agreed that meat and dairy products can be most economically produced on pasture.

The very extensive acreage occupied by lespedeza has made it desirable to emphasize the development of improved varieties. Increased attention has been given to the development of disease-resistant and higher-yielding strains. Varieties have been developed that will extend the use of the annual species both to the North and South. Improvement in cultural practices has received attention also, and progress has been made in determining fertility requirements.

A strain of sericea lespedeza with decreased tannin content has been selected and is being increased for further study. Field peas that have shown disease resistance likewise are being increased for further tests. Under proper crop rotation, disease losses in winter peas in the South can be considerably reduced.

Winter cover crops for increasing soil fertility and in turn crop production have been given emphasis and information regarding best adapted species and varieties made available. The development of varieties and strains, seed of which can be produced and used locally in the South, has received special attention.

Hay and pasture grasses. The combined production of meat and livestock products in the United States, if the livestock goals are reached in 1943, will be about 15% higher than in 1942. In addition, the carry-over of grains is likely to reduce to the minimum the quantity of available supplemental concentrates. Hay and pasture offer an important contribution in offsetting this reduction in concentrates, since pastures supply about 48% of the total annual feeding requirements in grazing, and about 12% of the hay requirements. With the pressure to increase the acreage of inter-tilled crops, there is greater need for increasing the productivity of hay and pasture crops.

In an area like the Corn Belt, where there is flexibility in the use of land for harvested crops or pasture, there is need for information on the cultural practices, seeding mixtures, fertilizer treatments, and grazing management systems that will be both practical and economical. Emphasis is also being placed on determining the effect of different renovation practices for the improvement of run-down permanent pastures. On native range land in Oklahoma, heavy late-summer grazing has proved detrimental to growth the following spring, whereas heavy fall grazing had no ill effect on subsequent growth.

Special attention is being given to developing improved, disease-resistant strains of pasture and hay grasses and to increasing seed supplies of these for distribution to farmers. Seed of Tift sudan grass, a disease resistant strain, particularly adapted to the southeastern United States,

will be under general distribution in 1944; and Lincoln brome grass, a strain of brome grass well adapted to the central Corn Belt, is already available for commercial use.

Greater emphasis, however, must be given to seed production of southern grasses under irrigation in the arid Southwest, since it is in this region that domestic seed production of Dallis, Bahia, Bermuda, etc., offers the greatest possibility.

With the prospects for an abundant supply of low priced nitrogen compounds for fertilizers, additional research work is necessary to determine the most efficient methods of utilizing these products in the production of hay and pasture.

Turf. It is estimated that in peacetime, over \$200,000,000 are spent annually in the United States for the production and maintenance of turf on lawns, parks, playgrounds, sports fields, cemeteries, airports, highway shoulders, etc. During the war emergency, additional millions are being spent on turf on Army and Navy airfields, cantonment areas, defense highways, housing projects, and other Federal projects. This turf cover is to protect equipment and personnel from damage due to dust and mud, as well as to serve for camouflage in some instances. Speed of establishment, density, and durability are the prime requisites in these emergency projects.

The Division of Forage Crops and Diseases has been called upon to supply information and assistance on such turfing projects conducted by several units of the War Department, Navy Department, Civil Aeronautics Authority, Housing Agencies, and the Public Roads Administration. All of these agencies are interested in more effective establishment and maintenance of turf and regard the growing of grass as an agricultural problem for which they should turn to the Department of Agriculture for guidance.

Our grass and turf specialists have inspected problem areas and provided consultation and advisory service wherever help was requested by the Army and Navy. Approximately 200 military sites have been serviced in this manner. During the current fiscal year such services have been curtailed, but are being provided on a reimbursable basis. Our specialists have determined by surveys the most effective methods now in use for establishing and maintaining turf on airfields. They have made recommendations for seeding, fertilizing, and other treatments based on an examination of the soil, climatic conditions, traffic and other factors affecting turf establishment and maintenance on each area.

(i) Forest Pathology

Appropriation Act, 1944	\$239,100
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+25,665
Total anticipated available, 1944	264,765
Budget estimate, 1945	255,300
Decrease	<u>-9,465</u>

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. Diseases of coniferous and: broadleaf trees and forest products:				
(a) Diseases affecting turpentine pines	\$ 10,100:	\$ 11,150:	\$ 11,150:	- -
(b) Little-leaf disease of southern pines	16,030:	17,040:	17,040:	- -
(c) White pine blister rust	15,200:	15,390:	15,390:	- -
(d) Dutch elm, phloem necrosis, and other elm diseases	33,760:	34,010:	29,195:	\$-4,815 (1)
(e) Maintenance of blight: resistant chestnuts and evaluation for tannin production	15,200:	16,995:	16,995:	- -
(f) London plane disease :	5,400:	4,650:	- -	-4,650 (2)
(g) Diseases of fir, pine, oak, and other trees, affecting timber stands and current lumbering operations	79,895:	54,074:	54,074:	- -
(h) Detection and avoid- ance of sap stain, de- cay, and other disease defects in forest pro- ducts used in boats, aircraft, and other construction	70,000:	103,283:	103,283:	- -
(i) Giant cactus di- sease in the Saguaro National Monument, Arizona	7,860:	8,173:	8,173:	- -
Covered into Treasury in ac- cordance with Public Law 674	1,515:	- -	- -	- -

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
Unobligated balance	3,500:	- -	- -	- -
Total available	258,460:	264,765:	255,300:	-9,465
Anticipated deficiency for overtime pay	- -	-25,665:	- -	
Total estimate or ap- propriation	258,460:	239,100:	255,300:	

DECREASES

The decrease of \$9,465 in this item for 1945 contemplates:

- (1) A decrease of \$4,815 due to curtailment of work on Dutch elm disease.
- (2) A decrease of \$4,650 due to elimination of work on the London plane disease, for which a practicable control method has been worked out.

The estimated distribution of these decreases by locations is: Beltsville, Maryland, \$5,507, and Morristown, New Jersey, \$3,958.

Statement of Overtime Costs

	1943	Est. 1944:	Est. 1945
Overtime absorbed	\$16,578;	\$ 7,204:	\$ 7,204
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	- -	25,665:	25,400
Total cost of overtime (7 months in 1943)	16,578:	32,869:	32,604

WORK UNDER THIS APPROPRIATION

Objective: The broad objective of the work in forest pathology is to increase the value of trees and to enhance the returns from timber and forest products, by reducing the occurrence of diseases and decay. Currently important aims are to preserve the health of forest and shade trees and to prevent damage from decay organisms to wood used for military and civilian purposes. Immediate objectives include: (a) Development of tree varieties resistant to specific diseases; (b) adaptation of forest-management practices to avoid losses from diseases; (c) devising methods of selecting trees and wood that will avoid damaged material without needless rejection of valuable wood; and (d) developing improved practices which will prevent decay in aircraft, ships, military and civilian buildings, and other places where wood is used. To attain these objectives, attention is given to the causes of disease and deterioration, to the factors by which they are influenced, and to methods for their control.

The Problem and its Significance: Diseases cause great damage in forests. Heart rots alone make it necessary to cull more than an eighth of the gross volume of the annual saw-timber cut. Diseases not only destroy wood but also cause needless loss of time and effort when their effects are not noted before cutting. It is important not only to combat disease but also to learn how to recognize in advance the damage already done. Recent trends in forestry intensify these needs. Selective logging methods, now being widely adopted, are likely to increase decay hazards unless this is especially guarded against. Improvement operations in second growth stands may fail if disease aspects are neglected. Forest and erosion-control plantings are hampered by losses from disease. Disease epidemics destroy shade and ornamental trees, leave city streets without trees, and reduce property values. Much of the lumber now being sold is from second growth and has a high proportion of sapwood, which renders it less resistant to decay than the lumber formerly available. Greatly increased uses of wood in aircraft and boats and the scarcity of standard protective fungicide materials raise many new problems. Wartime requirements for rosin and turpentine are high. This necessitates the development of safe methods for stimulating pitch flow and for controlling diseases that affect the freshly cut faces of trees.

General Plan: This work is directed almost wholly to the solution of current disease problems in connection with forestry, wood utilization, and shade-tree culture. Shifts in emphasis have been made to curtail work on diseases of forest and shade trees in order to expand work on decay and other disease defects in forest products used in aircraft, boats, and other wartime construction. Laboratory and controlled field tests are conducted in cooperation with the Forest Service, the Soil Conservation Service, the Bureau of Entomology and Plant Quarantine, the National Park Service, State experiment stations, municipalities, and nurserymen.

Examples of Progress and Current Program:

Turpentine production: In cooperation with the Forest Service, work is under way to develop and study the effects on pine trees of new methods of stimulating flow from turpentine pines by treatments of the chipped surfaces or "streaks" with sulphuric acid and caustic soda. The favorable results of last season's experimental tests already are in wide-scale practical use by operators this year, as the new procedures mean a saving in labor and increased production needed for the war effort. Tests are continuing with new treatments, and a close study is being made of any pathological effects of treatments now in use.

Little-leaf disease of southern pines: An experimental project for control of the little-leaf disease by eradication has been set up in cooperation with the Forest Service and covers 2,000 acres on the General Pickens area of the Sumter National Forest, in South Carolina, where the Forest Service administers the timber. The Division of Forest Pathology identifies the diseased trees, marks them for removal, and maintains maps showing location of diseased trees and the effect of their removal on the suppression

of the disease in the control area. Recently a serious outbreak of the little-leaf disease has appeared in this fine body of Government-owned timber, which is considered to be the best stand of shortleaf pine east of the Mississippi River. This disease, the cause of which is not yet known, has been attributed to soil deficiency, to the presence in the soil of deleterious substances, to soil fungi attacking the roots, or to a virus pathogen, all of which possible causes are being investigated. In the General Pickens area the soil is not eroded, the duff has not been destroyed by fire, and growth conditions are ideal. But the trees are dying from little-leaf. This occurrence of the disease confirms a large series of soil studies and tends to discredit the soil-deficiency hypothesis. There is a strong possibility that the disease may be infectious and it is important to determine whether it may be controlled by eradication. Previously, little-leaf disease was known only in trees about 20 years old and older, but here some much younger trees seem to be affected.

Dutch elm disease: A valuable strain of the American elm resistant to Dutch elm disease has been obtained by artificially inoculating with the causal fungus about 35,000 young elms grown mostly from seeds collected in New Jersey, New England, the Central, the Southern, and the Great Plains States. Of this collection, one tree has withstood severe inoculation for 3 successive years. This tree develops slight terminal dieback following inoculation and is therefore not entirely immune, but it does possess very satisfactory resistance. Two additional elm trees that show resistance to Dutch elm disease have been selected from crosses between the susceptible American elm and the highly resistant Siberian elm. These hybrids likewise have withstood 3 years of artificial inoculations severe enough to kill all susceptible elms. The resistant strain of American elm and the hybrids will be propagated and their progeny tested to determine whether in addition to possessing high resistance to Dutch elm disease they may also be resistant to phloem necrosis, which latter is a serious virus disease of the elm in the Ohio River Valley.

Blight-resistant chestnuts: Selected strains of blight-resistant Asiatic chestnuts planted on good sites have now reached a size sufficient to demonstrate their prospective value. Even though not equal to the American chestnut, they are now recommended for limited plantings by farmers. Some of the hybrids between the American and Asiatic chestnuts also look promising. Further tests are under way both with these hybrids and with additional strains of pure Asiatic chestnuts. No forest tree equals the chestnut in the diversity of its more important uses and in its value for the farmer. It produces edible nuts, tannin for leather manufacture, lumber, durable posts, and poles.

London plane disease: It has been determined that pruning tools provide a principal means of spreading London plane disease. The disease can be curbed by disinfecting tools with alcohol and covering pruning wounds with asphalt containing a phenolmercury compound.

Disease defects in plywood for planes and boats: The study of discolorations of yellow birch, yellow poplar, and red gum as affecting toughness and usability on curved surfaces has been completed, and most of the results are now available to inspectors and manufacturers in mimeographed form. In addition, sets of samples showing both the harmful and harmless discolorations have been made up for the guidance of inspectors and others concerned in aircraft and patrol boat manufacture. They have been in heavy demand, a total of more than 300 sets having been distributed. For all three species it has been found that some of the most conspicuous discolorations that had been causing rejections of valuable material are negligible in their effects; while some of the less striking discolorations indicate incipient decay and a dangerous weakening. Similar studies are in progress in both American and African mahogany, and in beech and basswood, which are likely to be needed as the strain on the supply of the other species increases.

Decay prevention in aircraft: The survey of decay cases at civilian repair stations has been completed and the study extended to military air fields and repair depots in the Southern States. In general, wood was found to give good service but most species used in aircraft are decay-susceptible, and serious damage has resulted in some cases from failure to exclude water or provide drainage. A confidential report on early findings on military planes has been submitted to the Army Air Forces and utilized in improving the design of one of the most-used primary trainers. The general conclusions justified by studies to date are embodied in a special release, copies of which are being distributed by the Army Air Force and the Civil Air Patrol to their personnel. Deterioration of aircraft parts in storage and transit, as well as in service, has been studied and made the basis of a report to the Army Air Forces.

Defects in aircraft lumber: Assistance has been given the Army Air Forces and the War Production Board in ending an impasse resulting from lack of information on the acceptability of yellow poplar lumber in which blue stain had developed in storage, which was making it increasingly difficult to get sufficient supplies of aircraft grades. In collaboration with technologists of the Forest Service, a study was made of flecks in western hemlock that had been widely mistaken for incipient decay pockets. These were shown to be purely chemical spots, not affecting the acceptability of the wood for aircraft. As a technical service to the war effort, at the branch office located at the Forest Products Laboratory examination was made of 191 specimens of spruce and various other aircraft softwoods submitted for diagnosis by Army inspectors and others because of suspicion of decay.

Decay reduction in boats: A survey of decay cases at ship repair yards and an analysis of the experience of marine architects and ship builders has been completed. A mimeographed release bearing on decay in boats and its prevention has been issued and 550 copies supplied in response to requests from the Navy, Coast Guard, Army Engineer Corps, Coast and Geodetic Survey, and Maritime Commission, for their personnel and contractors. In cooperation with the Philadelphia Navy Yard, experiments

have been started on the effectiveness of the surface fungicide treatments in joints now included in Government ship-building specifications. Accelerated decay tests have been made on the resistance of the different kinds of oak available for ship construction, and a report is in preparation. Outer heartwood was found approximately twice as resistant as the inner heartwood of the same trees, and heartwood of species of the black oak group appeared no more resistant than the sapwood of white oak; tests are continuing.

Prevention of decay in war housing: Moisture content in basementless construction has been followed in further quantitative studies on war housing. Very slight ventilation is found adequate to prevent decay where the building site is dry. Where soil remains wet, drops of condensation water often collect on joists and sills if ventilators are closed during cold weather. In preliminary trials, it has been found that condensation even in very wet situations can be prevented at moderate cost by covering the wet soil with asphalt roll roofing. This is being studied further, and ordinary building papers are being tried.

Prevention of deterioration in tanbark: During the past season, studies of the effect of current handling methods on bark deterioration were made in cooperation with tanneries using chestnut-oak and hemlock bark. A second series during the present season will probably complete the study. It was found that bark ricks should be located in well-ventilated places and that their top layers should be well shingled to prevent water from penetrating the ricks. Poor handling induces the growth of decay fungi and reduces the amount of available tannin. The increased demand for heavy leather, especially sole-leather, makes necessary all possible saving of tanbark.

Effect of chemicals, including fire-retardants, on the susceptibility of wood to attack by fungi: The very large wooden hangars which are being constructed for military balloons require treatment with fire retardants. Because the chemicals most commonly recommended contain nitrogen and phosphoric acid, there was reason to fear that they might stimulate decay in such structures which are exposed to the weather. Studies in collaboration with the Forest Products Laboratory have shown that these fire-retardant chemicals favor the growth of certain of the less harmful fungi and when used in low concentrations may also favor some of the decay fungi. However, when used at the strengths required for fire retardance they actually hindered development of the decay fungi against which they have been tested, and they did not appear to interfere materially with the effectiveness of wood preservatives when used in conjunction with them. Borax, also used in some situations where fire hazard is high, has given good results in fungus prevention. Results show that the mercuric and phenolic chemicals used for protecting green lumber against sapstain and other fungi can be conserved in the South and probably in the West by using much smaller quantities of these critical materials in mixture with relatively large amounts of borax. Borax is plentiful but is not sufficiently effective when used alone. The results have been made available in a preliminary report for restricted circulation.

(j) Fruit and Vegetable Crops and Diseases

Appropriation Act, 1944	\$1,361,828
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+142,600
Total anticipated available, 1944	1,504,428
Budget estimate, 1945	1,455,767
Decrease	-48,661

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Deciduous fruit investigations	\$280,340	\$ 270,800	\$ 270,800	-
2. Citrus, avocado, and other subtropical fruit investigations	108,750	114,210	102,953	\$-11,257 (1)
3. Nut investigations	221,050	247,768	236,348	-11,420 (2)
4. Vegetable investigations	299,230	379,610	372,213	-7,397 (3)
5. Potato investigations ...	102,880	110,330	110,330	-
6. Investigations of plants for landscaping and ornamental purposes	61,780	46,560	36,601	-9,959 (4)
7. Nursery stock and farm windbreak investigations ..	59,129	34,520	25,892	-8,628 (5)
8. Methods of handling, transportation and storage, and market diseases of fruits and vegetables, investigations of	190,430	223,040	223,040	-
9. Greenhouse experiments ..	69,657	77,590	77,590	-
Covered into Treasury in accordance with Public Law 674	2,290	-	-	-
Unobligated balance	33,103	-	-	-
Total available	1,428,639	1,504,428	1,455,767	-48,661
Transferred to:				
"Salaries and expenses				
Office of Administrator,				
Agricultural Research				
Administration"	+6,000	-	-	
"Salaries and expenses,				
library"	+7,900	-	-	
"Salaries and expenses,				
Office of Information" ..	+1,900			
Anticipated deficiency for overtime pay	-	-142,600	-	
Total estimate or appropriation	1,444,439	1,361,828	1,455,767	

DECREASES

The decrease of \$48,661 in this item for 1945 consists of the following reductions:

- (1) A decrease of \$11,257 in citrus, avocado, and other subtropical fruit investigations will be effected by discontinuing work at Riverside, California, on bud selection in citrus fruits. This work has been largely completed, and the industry is using the results.
- (2) A decrease of \$11,420 in nut investigations contemplates placing long-time pecan improvement work at Brownwood, Texas, and Shreveport, Louisiana, on a maintenance basis, and curtailment of work at Beltsville, Maryland on the development of hardy northern nut varieties, principally black walnuts and hickory nuts.
- (3) A decrease of \$7,397 in vegetable investigations contemplates discontinuing vegetable variety standardization work at Beltsville, Maryland, for the duration of the war.
- (4) A decrease of \$9,959 for investigations of plants for landscaping and ornamental purposes contemplates suspending for the duration work on the azalea flower-spot disease in Alabama and Maryland.
- (5) A decrease of \$8,628 in nursery stock and farm windbreak investigations will be effected by placing on a maintenance basis for the duration work at Beltsville, Maryland, on production and diseases of fruit-tree nursery stock.

The estimated distribution of the decreases by locations is as follows:

Alabama, Spring Hill	\$ 3,260	Maryland, Beltsville ...	\$27,153
California, Riverside	11,257	Texas, Brownwood	3,163
Louisiana, Shreveport	3,828		48,661

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$89,166	\$50,786	\$50,786
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	- -	142,600	138,689
Total cost of overtime (7 months in 1943)	\$89,166	193,386	189,475

WORK UNDER THIS APPROPRIATION

Objective: To insure as nearly as possible adequate wartime supplies of essential fruit, vegetable, potato, and nut crops through: (a) Determining most economical methods of soil management, fertilizing, irrigating, pruning, and harvesting to insure maximum production with minimum use of labor and strategic materials; (b) developing and disseminating information on diseases causing serious losses, and on how they can be controlled with existing materials; (c) devising methods of packing, shipping and storing to reduce losses and to economize in packaging materials and transportation equipment; (d) developing and making available as rapidly as possible varieties resistant to diseases and thus requiring less spraying, that are suitable for various uses including dehydration; (e) acting in an advisory capacity to war agencies relative to allocations of strategic fertilizers and spray and seed treatment materials, to securing supplies of vegetable seeds, and on methods of heavier car loading to conserve transportation equipment.

The Problem and its Significance: These crops are the great health protectors in human diet as well as highly important staple food sources. Greatly increased production under war conditions is needed in most of the individual crops, but particularly in potatoes, peanuts, sweetpotatoes, peas, and beans. Maximum output of fruit from existing acreage is desperately needed. Because of rapidly expanding dehydration of vegetables and potatoes, prompt determination of suitability of varieties for this purpose is of primary importance. Seed stocks of certain strategic vegetables are extremely short and rapid expansion of seed production into new areas is essential to meet domestic and allied needs. These needs for maximum production of all fruit and vegetable crops make dissemination of information on problems of disease control, seed supply and treatment, variety adaptation, soil management, fertilizer requirement, and all related production practices of maximum importance. Continued development of disease-resistant, better-adapted varieties is also essential to production with these strategic food crops.

General Plan: The work consists primarily of field and laboratory experiments largely cooperative with State agricultural experiment stations, other Federal agencies, and producers of horticultural crops. National headquarters are at the Plant Industry Station, Beltsville, Maryland, from which point direction is given to work located in the States of Alabama, Arizona, Arkansas, California, Colorado, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, Nebraska, New Jersey, New York, North Carolina, Oregon, South Carolina, Texas, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming. Many new problems are constantly arising in the present emergency due to shortages of fertilizers and materials for spraying and seed treatment, modified packaging and car loading, which can be met only by a continuing aggressive research program and the immediate release of information on the results obtained.

Examples of Progress and Current Program:

Changes in emphasis to meet war needs. During the past year certain lines of work formerly carried on have been curtailed in order to provide for expansion of other lines of work under this appropriation on which information is needed in connection with the war effort. For example, a new project on suitability of fruit varieties and strains for dehydration has been undertaken. Personnel to handle this project was made available through curtailment and placing on a maintenance basis the fruit-breeding program with apples, peaches, grapes, and small fruits. Investigations will include determination of the suitability for dehydration of a large number of varieties of fruits, including berries, grapes, peaches, apricots, and apples now being grown on experimental plots. Similar work is under way with vegetable varieties. This work is of direct importance under war conditions because of the tremendous need for dehydrated fruits and vegetables. Work is also under way to determine the vitamin content of varieties and strains of fruits and vegetables, as well as the possibilities of increasing vitamin content by growing, cultural, and handling conditions.

Investigations on vegetable seed production and diseases are being expanded because of the critical shortage of vegetable seed and the need for expanded acreage and improved disease control, particularly with such biennial vegetables as carrots, beets, spinach, onions, and cabbage. This work is made possible through a reduction in the investigational program on ornamental plants, nursery production, and diseases, and the transfer of personnel to these critical problems on vegetables, seed production, and diseases. Production and improvement of vegetables for cold and drought conditions are being expanded to meet wartime problems of food production in the Great Plains by placing the ornamental investigations and the farm windbreak work at the Cheyenne Horticultural Station on a maintenance basis.

The handling and transportation of fruits and vegetables has assumed tremendous importance during the war. This work has been expanded in a study of such problems as heavier loading of refrigerator cars to save shipping space, the use of substitute packages, such as fiberboard containers for fruits, and suitability of cotton and paper bags for unavailable burlap for potatoes, and methods of refrigeration to save ice, supplies which are critically short. Expansion of this work has been made possible by curtailment of work on diseases of nursery stock.

Deciduous fruit investigations:

Virus diseases in Washington State. The symptoms of virus diseases attacking peaches, cherries, and other stone fruits in Washington State have been determined, and descriptions published in cooperation with the Washington State Department of Agriculture. In this work technical assistance was given in a survey of orchards to determine the incidence of virus diseases. Data are being obtained on the rate of spread of the diseases and the possibilities of controlling them by eradication.

Red stele of strawberries. This disease, which became commercially established in the United States approximately 10 years ago, has spread to new areas through the distribution of infected plants. A soil once infected cannot be used again for strawberries for at least four years and probably for longer periods unless resistant varieties are planted. As a result of breeding for resistance to this disease, a new variety, the Temple, completely resistant to the disease, has been released in cooperation with the Maryland Experiment Station.

Nematode-resistant peach root stocks. It has been shown that roots of the Shalil and Yunnan type peaches imported by the Division of Plant Exploration and Introduction are extremely resistant to nematode injury. Open-pollinated seed of trees of these types carry satisfactory resistance for commercial use. By producing seedlings of these types and budding the desired varieties on them, loss from nematodes can be largely controlled.

Fruit thinning with caustic sprays. Removal of excessive sets of fruits of apples and peaches is one of the most time-consuming and laborious problems in commercial fruit production. Unless the fruit is thinned, small sizes and poor quality will result. Investigations under way on the use of sprays at blossom time to prevent an excessive set of fruit indicate that by using the right concentration and time of application of caustic sprays, such as elgetol, fruit set can be reduced and the amount of hand labor greatly lessened.

Substitutes for copper sprays. In tests on a large number of possible substitutes for copper-containing fungicides, it was found that the iron salt of dimethyldithiocarbamate (Fermate) was as effective as bordeaux mixture for the control of most of the diseases affecting the fruits of apple, pear, and cranberry, and in some instances was less injurious to the plant.

Citrus and other subtropical fruit investigations:

Cause of citrus "lumpy rind." It has been demonstrated that lack of boron in the soil can produce the so-called "lumpy rind," a condition of grapefruit characterized by darkening and gumming of areas in the white inner portion of the peel. It remains to be determined whether simple soil treatment with borax will correct the trouble under all orchard conditions.

Citrus psorosis or scaly bark disease. Further tests have shown that the virus disease of oranges and grapefruit known as psorosis can be detected in the nursery by a careful study of the first growth to emerge for characteristic leaf symptoms of the virus. The progenies of individual trees from which budwood is obtained should be maintained distinct in the nursery. All nursery trees in any progeny in which some trees are infected should be destroyed immediately. Bark symptoms are not apparent for a number of years after actual infection, and sometimes apparently healthy trees may transmit the disease through buds.

Reconditioning "dry" dates. A very serious grade-reducing factor in the date industry of the Southwest is the condition known as shrivel, which is associated with premature and excessive drying of the fruit before and during the ripening process. Recent investigations have developed a method for reconditioning such dry fruit by subjecting it to controlled conditions of temperature and moisture. Present investigations are directed to studying the effect of various wax emulsion sprays applied to the date fruits at pre-ripe stages to check water loss and thus prevent development of the shriveled condition.

New date variety. A large-fruited, high-quality date variety (Medjool), imported into this country by the Bureau, has been tested and released for propagation. The Medjool is less susceptible to rain and moisture damage than is the most important commercial variety Deglet Noor.

Nut investigations:

Thinning the stand of trees in crowded pecan orchard pays. Yields in 1942 from 30-year-old Stuart pecan trees spaced 4.7 trees per acre was 702 pounds per acre as compared with 321 pounds per acre from trees of the same age spaced 9.4 trees per acre. The difference in value of the pecans was approximately \$68.53. The yield of pecans from this thinned plot for the 13-year period from 1930 to 1942, inclusive, has averaged 685 pounds of pecans per acre per year. The average annual value of the pecans, calculated from the average price per pound received by the grower as reported in Agricultural Statistics for 1942, was \$101.79 per acre. The results from this and other experiments have been so outstanding that pecan growers have been quick to see the advantages that accrue from thinning their crowded orchards, and many thousands of acres of orchards have been thinned.

Wide differences in yields and quality of pecan nuts result from cultural and fertilizer practices. Wide differences in yields of pecans and in the quality of nuts result from cultural treatments that affect the amount of nitrogen available to the trees. Trees in the experimental plots which have had the highest level of nitrogen have been the most productive and those on soil which has the lowest level of nitrogen have been the least productive. The average difference in yield of nuts per acre has been 585 pounds, having a farm value of \$105.30 per acre. This difference was produced by cultural practices and orchard sanitation for disease and insect control, which cost approximately \$40.00 per acre per year.

Nitrogen and potassium increases yield of tung fruit. Four years' experiments on tung show that the application of 36 to 48 pounds of actual nitrogen per acre, in some quickly available form, increases the number of fruit-producing flowers formed in each terminal bud by from 20% to 30% and production of tung oil per acre by some 25% to 40%. These results show that ample nitrogen, either from mineral fertilizers or from legume cover crops, must be available to tung trees if maximum production of this highly strategic crop is to be secured. It also has been found

that tung trees have a very high potassium requirement, and that applications of potash in greater amounts than ordinarily furnished by a complete fertilizer application result in increased tree growth and greater yields of fruit with higher oil content.

Correction of dieback in walnuts. It has been determined that dieback or "snakehead" condition of Persian walnuts on certain soils in the Pacific Northwest is due to deficiency of boron, and that the difficulty can be corrected by applications of borax. In some cases the yield of nuts was more than trebled by such treatment.

Vegetable investigations:

Vegetable seed production. Within the year additional resources have been diverted from certain less critical problems to make further expansion in emergency seed-production studies in the West and Northwest. Supplies of cabbage, onion, and beet are very short and yields are low in the principal producing areas. Cultural and adaptation experiments are in progress in Colorado, Wyoming, Utah, Idaho, Washington, Oregon, and Arizona. Satisfactory yields of a number of these crops have been obtained in some new areas where these crops have not hitherto been grown commercially.

Beans. Pioneer, the first curly-top resistant snap bean, was released in cooperation with the Oregon Experiment Station in 1943. It is productive under curly-top conditions that give zero yields of other varieties, and it thus makes possible snap bean production in certain Inter-mountain areas where other varieties may fail completely.

Melons. Mildew Resistant Cantaloupe No. 5 was released in cooperation with the California Experiment Station less than a year ago. In 1943 about 4,000 acres of it were grown in the Imperial Valley, where all other varieties suffer serious mildew damage. It drew praise from shippers and growers alike. This is the second time that the breeding project has saved from ruin the biggest melon district in the country.

Producing sweetpotatoes for feed and industrial use. Cooperative studies with southern experiment stations have developed rather radical departures from usual methods of planting sweetpotatoes. The new practices greatly lower the cost per acre and per ton when growing sweetpotatoes for stock feed or starch manufacture. Safe limits of delayed digging to extend starch plant operation without the costs of conventional storage have been determined in various regions. The harmful effects of too early digging (or too late) upon starch content were demonstrated. Knowledge on several points is basic to safe estimates of probable success of production for new uses of sweetpotatoes both now and after the war.

Vegetable varieties for dehydration. In response to demands from military, lend-lease, and commercial sources, the relative suitability of a large number of vegetable and fruit varieties for dehydration has been determined.

The number of varieties already studied are: Potatoes 20, sweetpotatoes 31, onions 12, sweet corn 34, snap beans 13, apples 10, and peaches 70. Effects of nine regions of production, and of certain fertilizer treatments on quality of dehydrated potatoes, were also studied. Regardless of place or treatment, conditions and varieties that give high specific gravity of tubers, give good dehydrated potatoes; low specific gravity, gives low quality.

Vegetable plants for northern shipment. More than 10,000 acres of vegetable plant beds in the South are grown for supplying tomato, cabbage, and other plants to canners, and other growers to the northward. Work on this project has increased the number of merchantable plants harvested per acre of bed about 60%, or 30,000 plants per acre, chiefly through improvements in time of planting and thoroughness of disease control. Recent findings on handling and shipping have sharply reduced losses in transit and losses in stand and from plant-borne disease after transplanting in the North. Plant growers and buyers alike have profited greatly from this work.

Tomato and bean diseases. Bulletins have been prepared and published, bringing together all present information on diseases affecting tomatoes and beans in all parts of the United States, and on methods of their control. These publications, based on years of investigation, are of great value to growers, inspectors, and county agents in determining causes of loss and prescribing remedies.

Onion investigations. A method not heretofore used with other crops has been developed for the production of hybrid onion seed. This consists of interplanting male-sterile and male-fertile (normal) lines of onions in the field. Cross pollination is done by insects, and all of the seed produced on the male-sterile plants is hybrid seed. Hybrid strains out-yield the parental varieties by 15% to 25% or more and besides are more uniform in size, shape, color, time of maturity, and other characteristics. Foundation seed of a number of varieties is now available, and this will be distributed to the various State experiment stations that are interested in developing hybrid strains adapted to their local conditions.

Thrips-resistant strains of the various varieties are progressing satisfactorily. A thrips-resistant strain of Yellow Bermuda is being increased for Texas, and thrips-resistant strains of Mountain Danvers for Colorado will be ready for increase next year. Two mildew-resistant strains are being increased in California.

Potato investigations: Ten of the new varieties of potatoes distributed to growers through the National Potato Breeding Program within the last 10 years are rapidly replacing the old standard varieties. Seed of these ten varieties in 1942 amounted to 5,754,820 bushels or 28% of the total certified seed produced. In 1942 the average yield per acre of potatoes in the United States was approximately 136 bushels. The 10-year average for 1930 to 1939 was 112.6 bushels. Part of the increase shown can be

attributed to the disease-resistance and greater-yielding capacity of the new varieties.

New varieties named in 1942. The Pawnee (Colorado Seedling No. 1608), a selection from the cross Rural x Katahdin, is the first variety distributed to growers as the result of potato breeding at the Potato Experiment Station, Greeley, Colorado. The Pawnee is a medium-early variety, producing good yields of round, white, smooth tubers. When grown in Colorado and in Maine the tubers have good cooking and keeping quality.

The Mohawk, selected at Presque Isle, Maine, from a cross of Green Mountain x Katahdin, is a midseason variety; plant similar to Green Mountain; adapted to conditions favorable to Green Mountain; recommended for production as a fancy baking type; first distributed commercially in New York in the fall of 1942. It is more resistant to mild mosaic than is Green Mountain.

U. S. Department of Agriculture 528-118 is the first variety produced that combines resistance to blight and scab. No late blight has been observed on its vines in Michigan. It also shows blight resistance in New York and Maine.

Ornamental investigations: The investigational program on ornamental plants and nursery production has been markedly curtailed. The valuable bulb and floricultural stocks which have been developed have been placed on a maintenance basis for the duration. Greenhouse space is being utilized for studies on problems concerned with vegetable seed production and disease control, including onions, carrots, and beets, the growing of waxy corn for seed, and for studies on various critical plants that are of special importance as sources of drugs and oils.

Easter lilies which have been developed by this Division during the past several years to replace the stock of lilies formerly imported from Japan are being grown in the southeastern part of the United States by farmers to produce bulbs for market. This makes a valuable cash crop in areas where soil and climate are adapted to the production of this crop. During the past year 8 new unnamed Easter lilies, superior to varieties formerly imported from Japan, were distributed for trial to 25 cooperating growers located in all sections of the country.

Growing large tulip bulbs. Before the war the United States imported from 125,000,000 to 140,000,000 tulip bulbs each year. American-grown tulips have been generally smaller than imported bulbs because they tend to divide into small bulbs when grown under our conditions. Results over a period of years have shown that this sort of splitting in the variety Clara Butt may be largely eliminated by deep planting.

Methods of handling, transportation and storage, and market diseases of fruits, vegetables, and flowers:

Bagging dry beans. Investigations were conducted on methods of packaging dry beans to withstand prolonged exposure to high humidity and high temperatures such as might be encountered in providing supplies of food materials for the armed forces under tropical conditions. This work was done at the request of the War Production Board and the Agricultural Marketing Administration in cooperation with The Paper Shipping Sack Manufacturers Association and The Textile Bag Manufacturers Association. In non-moisture proof containers the beans were spoiled within 2 weeks but in the best moisture-proof bags they were in good condition after 2 months, which is as long as the tests were run.

Control of citrus decays. Diphenyl-treated wraps were found to be extremely effective in controlling stem-end rot and *Penicillium* rots of Florida oranges. After three weeks, fruit in plain paper wraps or unwrapped showed 5 times as much rot as diphenyl-wrapped fruit from the same lot. Diphenyl seems to be somewhat more effective against stem-end rot than against blue mold. The treated paper has a strong, somewhat objectionable odor, but this is not imparted to the fruit.

Fibreboard as a substitute for ordinary wood containers. War-induced shortage of wood and steel (wire and nails) has forced the fruit industry to look for substitute containers. Tests were made with fibreboard boxes for citrus fruit and apples, variously designed and constructed boxes being included. It was found that in routine warehouse operations the wood box was superior and that the fibreboard softens when subjected to prolonged storage in high atmospheric humidity, also from moisture which condenses on the cold fruit when it is removed to a warm place. This softening is more serious with boxes for apples which need a rigid container than for citrus fruit. Despite this disadvantage, however, shipping tests with apples from the Northwest showed that the fruit carried fairly well in fibreboard boxes. Most of the shipping tests with citrus fruit turned out satisfactorily, although certain weaknesses (chiefly in closure) were brought out in some of the containers. It is probable that more fibreboard will have to be used next year so that this year's results yielded information that will be needed then.

Substitutes for burlap for potato bags. Cotton sheeting, Osnaburg and Victory cloth proved to be suitable substitutes for burlap, no longer available in many places because of the war. Tan colored Osnaburg and Victory cloth are preferable because they do not become unsightly and spotted from wet potatoes or from rubbing against the floor or walls of the car during shipment. Multi-ply paper bags also proved satisfactory in sizes up to 50 pounds. Discoloration of skinned new potatoes was reduced in the tight paper bags but decay tended to be somewhat greater because of the high humidity unless the potatoes were adequately refrigerated.

Heavier loading of refrigerator cars. Tests were continued on heavier loading of refrigerator cars to determine how the size of the load could be increased safely with sweet cherries, citrus fruit, melons, potatoes, and onions. Some of this work was done at the request of the Office of Defense Transportation in advance of issuing rules or directives. As a result of our tests, loading requirements were modified for citrus fruit, new potatoes, onions, and cabbage. Our results have thus been useful to O.D.T. in its efforts to utilize refrigerator-car space to maximum capacity and conserve motive power, and useful to the industry by indicating how the O.D.T. requirements can be met most satisfactorily. Use of fan cars permits heavier loading of all commodities, but the number of cars thus equipped is limited. Use of CO₂ permits heavier loading of sweet cherries and some varieties of plums. Thorough precooling is needed with all commodities, and changes in loading or stowage patterns are required with many.

Stage, or upper-half-bunker, icing of refrigerator cars. From investigations conducted during the past 9 years, it has been found that California orange shippers can safely reduce the amount of ice they use, particularly in the newer types of refrigerator cars, by the use of stage icing, that is, by placing ice in only the upper half of the bunkers. Stage icing not only reduces the ice bill but also saves needless freight costs--economies that vary in amount with the different types of refrigeration and are of the utmost importance in the present emergency. Considering that the refrigerated orange shipments from California amount to more than 50,000 carloads a year and that ice costs \$3.50 to \$5.00 a ton, the annual savings from stage icing, in cost of ice is estimated at nearly a million dollars to the fruit industry. In addition, there is the very considerable saving of much needed motive power because of the greatly reduced weight of ice that must be hauled to eastern destinations and the elimination of a large part of the unused ice which is left in the cars with full bunker icing when they are unloaded, and is ordinarily allowed to melt as the empty cars are hauled back to California. Results similar to those obtained with citrus fruit from California have also been obtained with citrus fruit, celery, and potatoes from Florida. A bulletin entitled "Stage icing in the refrigeration of oranges in transit from California," based on the investigations mentioned, has been published.

As a consequence of these investigations, the Interstate Commerce Commission has issued Service Order 132 directing the carriers to publish in their tariffs, half-stage icing arrangements at reasonable rates.

(k) Irrigation Agriculture

Appropriation Act, 1944	\$134,900
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+16,900
Total anticipated available, 1944	151,800
Budget estimate, 1945	145,000
Decrease	<u>-6,800</u>

PROJECT STATEMENT

Project	1943	1944	1945	Increase or decrease
	(estimated)	(estimated)	(estimated)	
1. Investigations of crop production on irrigable lands, the quality of irrigation water, and its use by crop plants:				
(a) Crop rotation and cultural investigations under irrigation	\$ 84,350:	\$ 97,938:	\$ 97,938:	-
(b) Quality of irrigation and drainage waters ..	31,297:	27,895:	26,095:	\$-1,800 (1)
(c) Water requirements of crop plants	20,970:	25,967:	20,967:	-5,000 (2)
Covered into Treasury in accordance with Public Law 674	220:			
Unobligated balance	9,383:			
Total available	146,220:	151,800:	145,000:	-6,800
Anticipated deficiency for overtime pay	-	16,900:		
Total estimate or appropriation	146,220:	134,900:	145,000:	

DECREASE

The reduction of \$6,800 in this item for 1945 consists of:

- (1) A decrease of \$1,800 to be effected by curtailing work at Riverside, California, on the effect of boron on crop plants.
- (2) A decrease of \$5,000 contemplated by the discontinuance of work at Indio, California, on the amounts and methods of application of irrigation water for maximum production of citrus fruits and dates.

Statement of Overtime Costs

	: 1943	: Est. 1944:	Est. 1945
Overtime absorbed	:\$5,886:	\$ 4,416:	\$ 4,416
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	: 4,000:	16,900:	15,983
Total cost of overtime (7 months in 1943) :	9,886:	21,316:	20,399

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: The broad objective of this work is to aid in insuring a successful irrigated agriculture in the United States, by determining: (a) The best varieties of crops, crop rotations, and fertilization and irrigation practices; (b) the progress of injurious salt concentrations in irrigation and drainage waters and in the soil solution, and where necessary recommending corrective measures; (c) the quantities of irrigation water required by different crop plants under varying conditions of soil and climate; (d) methods of measuring the day-to-day changes in the quantity of available water in the root zone of the soil to be used as a guide for the most efficient use of irrigation water; and (e) the possibilities of increasing production of irrigated crops now urgently needed in the country's war efforts.

The Problem and its Significance: The irrigated lands of the western United States comprise approximately 20 million acres. These lands occur in isolated areas contiguous to streams in the arid region. They are surrounded by extensive areas of semiarid land used for dry farming, and for grazing. The agricultural enterprises of the irrigated lands and of the surrounding semiarid lands are mutually interdependent, since the irrigated lands are sources of feed crops to supplement the ranges and, conversely, the use made of the forests and ranges directly affects the water supply for irrigation.

Because the operating expenses of irrigation farming are relatively high, involving service costs of irrigation water and the labor of applying it to the land, the crop yields must also be relatively large. Furthermore, the costs of the construction of works for the storage and distribution of irrigation water are so large that they must be liquidated over a long period. Permanency and sustained productivity of irrigated land are thus essential to economic success. The information already made available has contributed to a more stabilized agriculture throughout the arid and semiarid West. Recent and continuing adjustments in the work are expected to yield information of greater usefulness in meeting current problems.

Approximately one-half of the total supply of irrigation water in the western United States contains dissolved salts in such quantity as to be potentially injurious to the irrigated land unless adequate measures are taken to provide root zone leaching and subsoil drainage. Dissolved salts occur naturally in irrigation waters. Most of these salts are not absorbed by plants, but remain dissolved in the soil solution until removed by drainage. Drainage water from irrigated land is returned to the streams from which the irrigation water was diverted. Consequently, along streams to which diversions are made, the stream water becomes progressively more concentrated in the downstream direction. With the increased concentration of dissolved salts in the water, larger quantities of water must be used for root zone leaching in order to prevent salt concentrations harmful to plant growth.

In most irrigated areas much more exact information on the water requirements of various crops is necessary if the most economical use of water is to be attained. The quantity of water required by various crops varies widely under different soil and climatic conditions. Knowledge of the water requirement of different crops under given conditions constitutes a basis for decreasing water costs and increasing the yield and quality of the crops produced.

General Plan: The work is done primarily at field stations supplemented by necessary laboratory experiments. These field stations are located on Federal reclamation projects and the facilities available are used for cooperative investigations by other divisions of the Bureau of Plant Industry, Soils, and Agricultural Engineering, by the Bureau of Animal and Dairy Industry, and by the several State experiment stations. The use of land and of irrigation water has been provided by the Bureau of Reclamation, and this agency has also contributed some buildings and special aid in land-leveling and ditch construction. The field stations are located at Huntley, Montana; Newell, South Dakota; Scotts Bluff, Nebraska; Fallon, Nevada; Bard, California; and Hermiston, Oregon. Cooperative investigations are conducted also at a State Branch Experiment Station at Prosser, Washington.

Investigations on salt constituents of irrigation and drainage water involve cooperation with the Bureau of Reclamation, the Geological Survey, and the Office of Indian Affairs, all of the Department of the Interior, and corporate irrigation districts. These agencies collect samples of irrigation and drainage waters at appropriate gaging stations where the volume of discharge is regularly measured. These water samples with the discharge data are sent to the laboratory at Riverside, California, where the water is analyzed and the quantities of salt constituent conveyed past each station are computed. Thus the annual input and output of dissolved salts (the annual salt balance) of an irrigated district is determined. If, in any district, the salt balance is adverse, that is, if the salt input exceeds the salt output, remedial measures are indicated.

Examples of Progress and Current Program: During the present national emergency increased attention is focused on the irrigated areas of the western United States. Long-continued investigations with crop varieties

and cultural methods are making substantial contributions to effective utilization of arid lands and water resources. Emphasis is being placed on furnishing information to farmers in irrigated areas in meeting war production goals. This information is generally applicable to the approximately 20,000,000 acres of irrigated land in this country. The construction of irrigation works, now authorized or in progress, will make available for intensive crop production several hundred thousand acres of land not heretofore available.

In cooperation with crop specialists of the Bureau at various field stations of this Division, facilities are being used to test the potentialities of new crops now urgently needed because of war conditions. Tests are being conducted with drug plants, castor beans, condiment plants, and guayule and other rubber plants under irrigation. Work has been continued to obtain and furnish to the Bureau of Reclamation, corporate irrigation districts, and other cooperators information on the salinity conditions of irrigation waters and of subsoil and drainage waters of irrigated lands. The sustained productivity of extensive areas in the West is dependent upon remedial measures indicated by this information.

Revisions have been made in the experimental irrigated crop rotations in the direction of more emphasis on the use of farm manure and chemical fertilizers. Different irrigated cropping systems, including the use of alfalfa in rotations and the application of farm manures, have been evaluated for the North Platte Valley in Wyoming and Nebraska. Results showed the value of manure to be above \$4.00 per ton, and alfalfa in the rotations has materially increased the net annual returns per acre. A continuing research program is essential to provide facts to insure adequate crop yields under changing conditions resulting from long-time and more intensive use of irrigated lands.

An instrument (tensiometer) for determining changes in moisture of field soils is being thoroughly investigated. This instrument accurately determines the depth in the soil from which water is withdrawn by crops. In one region alfalfa, a normally deep-rooted plant, extracts water from only about 18 inches of soil. Such findings make it possible to use irrigation water more efficiently and economically. Tensiometers have been installed at four field stations to collect information on the root zone range and water requirements of several different crops. In irrigated areas more precise information on water requirements of crops is necessary to make possible the most efficient and economical use of irrigation water.

Results of irrigation tests with American-Egyptian cotton in Arizona continue to show beneficial effects from early irrigation in stimulating early fruiting and increasing yields, although early irrigation has not been a commonly accepted practice. It also appears that certain soils, sandy soils of low fertility, require more water in late season than do heavier soils of good fertility. The benefit from increasing the intervals between irrigation after July is dependent on the set of bolls obtained--if a good crop has been set there is no benefit from drying the plants in August, but if the set of bolls is not good, greater yields may be made by lengthening the interval between irrigations at that period.

(1) National Arboretum

Appropriation Act, 1944	\$38,000
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+4,900
Total anticipated available, 1944	42,900
Budget estimate, 1945	31,500
Decrease	<u>-11,400</u>

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. National Arboretum: Main- tenance and operation of Arboretum	\$50,197:	\$42,900:	\$31,500:	\$-11,400 (1)
Unobligated balance	4,695:	- -	- -	- -
Total available	54,892:	42,900:	31,500:	-11,400
Anticipated deficiency for overtime pay	- -	-4,900:	- -	-
Total estimate or ap- propriation	54,892:	38,000:	31,500:	-

DECREASE

(1) A decrease of \$11,400 in this item for 1945 to be effected by reducing labor costs and purchases of supplies and materials. This will continue the Arboretum on a maintenance basis, and only such plantings will be made as are necessary to save plants now growing in the nurseries that must be transplanted to avoid loss.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$3,618:	\$1,330:	\$1,330
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimates, 1945)	- -	4,900:	3,500
Total cost of overtime (7 months in 1943)	3,618:	6,230:	4,830

WORK UNDER THIS APPROPRIATION

Objective: To establish and maintain a National Arboretum with a diversity of tree and other plant life for research and educational uses, in conformity with the authorizing Act (Public No. 799-69th Congress).

The Problem and its Significance: The work at the National Arboretum has been and is now primarily on a maintenance basis. The planting work now contemplated is necessary to save plant materials propagated in the nurseries during recent years. These plants are increasing in size so that many of them must be transplanted each year or they will be lost. In order to obtain the largest possible amount of plant materials at lowest cost, there have been developed rather large nurseries grown principally from seeds and cuttings, together with some purchases and plants received through the facilities of the Bureau. The purchase of good-sized specimens of these various stocks would have greatly increased the cost of the Arboretum. This nursery material now covers an area of approximately 50 acres, and much of it has reached the stage where it should be transplanted and cared for to prevent its loss.

Maintenance work is necessary in connection with drainage and erosion problems, repairing and constructing fences, cutting of brush and weeds, and maintaining soil through cover cropping and fertilizing. Considerable planting has been done in the past on the 400 acres of the Arboretum, and it is necessary that these plantings be cultivated, kept free from weeds, fertilized, and in some cases watered. Unless this work is done, part of the material will die, and the investment put in to date will be lost.

The essential problem at the Arboretum is, of course, the development of the Arboretum into a living collection of all woody plants that can be grown in the District of Columbia, to serve as a source of plant materials and educational information concerning plant life for students and scientists throughout the country. With a great storehouse of plant materials from all corners of the world established at the Arboretum, breeders of trees, shrubs, and flowers will have an opportunity to cross native species with those from foreign lands for the development of improved strains adapted for special purposes such as for city parks, forest, boulevards, and streets. It is expected to make the facilities of the Arboretum available to scientists all over the world, and cooperation is contemplated with foresters, botanists, horticulturists, and other scientists in the improvement of trees, shrubs, and other plants. The Arboretum thus becomes an educational institution which at the same time will provide an abundance of growing plant material for scientific purposes. In order to be most useful for purposes of research and education, the Arboretum is being planned and developed with a view to: (a) Taking the fullest possible advantage of all environmental factors at the site selected, such as soil type, slope, exposure, and drainage; (b) the grouping in the most suitable locations of all the adapted plants of many genera or species; (c) making them available for general observation and detailed study; and

(d) preserving for reference, identification, and classification, herbarium specimens of all plant materials likely to be of value in this country.

General Plan: The National Arboretum is located in the District of Columbia, bounded approximately by M and R Streets, N. E., Bladensburg Road, and the Anacostia River. An advisory council, appointed by the Secretary of Agriculture in accordance with the Act of March 4, 1927 (20 U. S. C. 191-194), assists in planning the development of the Arboretum. Plant collections generally are established in nurseries at the Arboretum prior to being placed in permanent plantings. Plant materials are obtained by purchase, gift, and by transfer from our Division of Plant Exploration and Introduction, a source of exotic plants from foreign countries.

Examples of Progress and Current Program: Through available facilities of the Bureau, additional collections of plant materials were propagated for later transplanting to the Arboretum. Continued maintenance and care are being given both to permanent plantings and established nurseries at the Arboretum.

A permanent planting of species of maple has been completed insofar as materials are now available, and plantings of holly and magnolia in permanent locations are now under way, using material propagated in the nurseries. A permanent planting of various species of azalea also is under way. Detailed studies are being made of Arboretum areas in connection with the establishment of specialized plant collections and the development of landscaping features. During the past year, work on the physical development of the Arboretum has included road surfacing with cinders, grading, and extension of the water system.

(m) Plant Exploration, Introduction, and Surveys

Appropriation Act, 1944	\$286,160
Anticipated deficiency for overtime pay required by the	
War Overtime Pay Act of 1943	+35,220
Total anticipated available, 1944	321,380
Budget estimate, 1945	290,000
Decrease	<u>-31,380</u>

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Crop plant introduction and testing, including plant classification and adaptation investigations	\$176,590	\$194,925	\$168,574	\$-26,351 (1)
2. Identification and classification of economic and plant-disease fungi	34,710	35,864	30,835	-5,029 (2)
3. Rubber production, breeding, and disease investigations	28,170	32,800	32,800	- -
4. Nematology investigations	53,488	57,791	57,791	- -
Covered into Treasury in accordance with Public Law 674	180	- -	- -	- -
Unobligated balance	9,265	- -	- -	- -
Total available	302,403	321,380	290,000	-31,380
Anticipated deficiency for overtime pay	- -	-35,220	- -	
Total estimate or appropriation	302,403	286,160	290,000	

DECREASES

The reduction of \$31,380 in this item for 1945 consists of the following decreases:

(1) A decrease of \$26,351 in crop plant introduction and testing, including plant classification and adaptation investigations to be effected as follows:

(a) Reduction of \$8,913, involving the closing out of work at the U. S. Plant Introduction Garden, Savannah, Georgia, on testing, propagation, and distribution of economic bamboos for trial in the South and on the West Coast; on building up stocks of several improved varieties of ramie obtained from Japan just before the war; and on varietal testing of introduced pears and persimmons.

(b) Reduction of \$3,438 at the U. S. Plant Introduction Garden, Coconut Grove, Florida, by curtailment of work on testing and propagation of tung and related species, oil palms, insecticide plants, citrus, coca, essential oil grasses, and other tropical plants.

(c) Reduction of \$995 at the U. S. Plant Introduction Garden, Chico, California, contemplating curtailment of work on testing of introduced varieties of pistachio nuts, walnuts, peaches, apricots, Asiatic persimmons, and nectarines.

(d) Reduction of \$3,946 at the U. S. Plant Introduction Garden, Glenn Dale, Maryland, by curtailment of work on special propagation techniques for cinchona (quinine) and other plants.

(e) Reduction of \$9,059 for work at Beltsville, Maryland, contemplating curtailment of work on the specific identification of plant materials for other divisions of this Bureau and for the Soil Conservation Service, Forest Service, and other Government agencies; and furnishing information on the location and characteristics of economic plants, particularly in tropical countries (e.g., rotenone, quinine, tannin, vegetable oils, etc.).

(2) A decrease of \$5,029 in identification and classification of economic and plant-disease fungi by curtailment of work at Beltsville, Maryland, on methods of improvement of commercial mushroom culture.

The estimated distribution of the decreases by States is as follows:

California	\$ 995	Georgia	\$ 8,913
Florida	3,438	Maryland	18,034
			31,380

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	*\$21,665	\$11,447	\$11,447
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	1,000	35,220	30,880
Total cost of overtime (7 months in 1943):	22,663	46,667	42,327

*Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: The central purpose of this work is to fortify crop production, improvement, and disease-control research by introducing and providing information on foreign plants, providing data needed in disease-control studies, and gathering and disseminating information on nematodes. Emphasis is now being placed on providing foreign plant materials and information regarding them needed to produce in this Hemisphere essential war crops once imported but now unavailable or scarce. More specific objectives are: (a) To supply from foreign sources--through exploration and exchange, gift, or purchase--plant materials of promise in this country; (b) to propagate

for use in this Hemisphere the plant materials needed to grow cinchona and other such crops for the quinine and other critical substances once imported from sources no longer available; and (c) to promote the best use of foreign plant materials in this country by obtaining and disseminating information on the plants' native habitats and natural growth habits. Other objectives in connection with work under this appropriation are: (a) To provide the armed forces with information on plants native to foreign areas; (b) to determine the rubber-bearing value of various plants, both native and introduced, and the possibilities of producing the various rubber plants in this Hemisphere; (c) to maintain a reliable service in identifying plants, plant diseases, and nematodes by collecting, preserving, and making reference use of specimens of crop plants and disease organisms; (d) to collect and make available information on the incidence, identity, and current status of plant diseases throughout the United States; (e) to study the principles underlying the growth and development of fungi, with special reference to edible forms and the improvement of practical methods of growing mushrooms for food; and (f) to develop practical methods to control nematodes attacking crop plants through the use of resistant crops and crop varieties, devising cultural and other means of utilizing the natural enemies of nematodes, and through studying them in the soil as related to crop production.

The Problem and its Significance: The war has altered Bureau activities on many plants such as cinchona (quinine), rotenone-producing plants, abaca and secondary fibers, oil plants, and medicinals other than quinine, which now can be obtained only in this Hemisphere. Special emphasis is given to securing and transmitting propagating stocks of these important plants for use in Latin American countries to develop products that we need.

To safeguard incoming plant materials and existing crop plants, services for quarantine, fumigation, detention, and propagation must be maintained. It also has been necessary under present conditions, in order to expedite production in Latin America of essential plants which cannot be grown here; particularly cinchona (quinine) and derris (rotenone), to carry out preliminary mass propagation here under greenhouse conditions. Methods of transporting such materials to the place of use are also receiving attention.

Most plant material is introduced with specific uses in mind, but an occasional plant given a routine examination may prove to have important commercial characteristics not previously expected. It may prove, for example, to be a source of drying or essential oil, tannin, rubber, fiber, or food. It may also show resistance to cold, heat, drought, disease, or nematode attack and thus be useful for crossing with a commercial species in order to obtain a better variety.

To make the best possible use of an introduction, to aid in establishing production in the Western Hemisphere of medicinal and other plants needed in the United States, and to furnish assistance on camouflage and other plant problems related to the war effort, it is essential that plant

species be studied, their susceptibility to various diseases known, and the existence or absence of such diseases determined for the areas where a particular plant is to be used. This calls for the maintenance of extensive herbaria in which are preserved thousands of plant and plant disease specimens, so that accurate identification and classification may be assured.

General Plan: Plant introductions are planned to meet as far as practicable the needs of crop specialists in this Bureau and in cooperating State experiment stations, the Soil Conservation Service, and other agencies. An inspection service is maintained in Washington, D. C., in cooperation with the Bureau of Entomology and Plant Quarantine. Detention facilities are provided at Glenn Dale, Maryland, and testing facilities at various other places in cooperation with Federal and State agencies and a limited number of private agencies. These test areas are sources of material for use by crop specialists and for planting stock of strategic materials. Economic herbaria of plants and plant disease specimens are maintained, and technical services are rendered to other divisions of the Bureau and to cooperating agencies in the government and elsewhere in the identification, classification, and use of materials. A plant-disease survey is kept current to supply necessary information on the plant-disease situation in various parts of the United States used by other Divisions of the Bureau and the States in disease control. Nematological studies show the reaction of various plants to nematode attack, the enemies and diseases of nematodes, and a basis for control measures.

Examples of Progress and Current Program: Production of seedlings of quinine continues on a major scale, involving research that will be useful to cooperative producing centers in Latin American countries. During 1943, in collaboration with the Office of Foreign Agricultural Relations and the War Department, more than 220,000 seedling trees were despatched to Mexico, Brazil, Nicaragua, Costa Rica, El Salvador, Ecuador, and Peru, and smaller shipments of special materials were provided for Puerto Rico.

Similar work is under way with rotenone-producing plants (derris and lonchocarpus) and with secondary fibers (principally luffa, and roselle). Special studies are being made with possible insecticidal plants (the yam bean, for example), and with medicinals other than quinine. Several hundred seedlings have been propagated of high-yielding strains of "Abrasin", a relative of the tung tree which promises to be valuable in a breeding program to increase hardness in tung. Each of the strains, obtained with difficulty from occupied China, has been triplicated to safeguard survival.

Plant distribution and plant products: Numerous miscellaneous inquiries are being received from war agencies regarding information on plants, plant distribution, and plant products in various parts of the world. A study of the identity and distribution of the wild plant in Mexico producing "chilte" rubber has been completed. Information on the plant and its relatives has been published and

distributed to the field by the Rubber Development Corporation to aid in the procurement of latex from wild stands. In cooperation with the Office of Foreign Agricultural Relations, data on plants in Latin American countries are being accumulated, with particular reference to crops of interest to the United States. Many plant products of Latin America, such as quinine, rubber, rotenone, palm oils, certain oil nuts, and fibers, are collected in the wild, and a knowledge of their extent, distribution, and accurate identity is imperative. Reports based upon botanical and collector's notes are often the only source of information on location and distribution on available supplies, and on disease or other problems.

Exchange of plant materials has been maintained with foreign agricultural institutions and botanic gardens. From such sources during the year more than 2,250 items have been brought in and supplied to other divisions of the Bureau and to other Federal agencies and State experimental stations. Included among these items were hybrid and waxy corns from Argentina, hybrid corn and oats from Chile, quinoa for the Department of Interior, and special South American potatoes. Some 139,442 items have been placed in experimental plantings in this country, and 75,688 have been sent to other countries. Over 20,000 plant specimens were received for identification from the Forest Service, Soil Conservation Service, Park Service, and other Federal Agencies, State experiment stations, public and private institutions, and individuals. Correspondence with Latin American countries has almost doubled.

Economic and plant-disease fungi: Identifications have been made in large numbers for State and Federal workers and others interested in plant-disease fungi causing losses to economic plants in this country. Similar studies have been made of fungi from various of the Latin American countries, in cooperation with agricultural officials of the countries concerned and information furnished on plant diseases and related fungus problems. Much of this type of assistance to these countries was formerly furnished by botanists attached to the museum at Berlin-Dahlem. During the year 13,134 fungus records were added to the files, together with the listing of 1,957 new species. The economic fungus herbarium now totals 442,551 specimens, 3,455 additions having been made in the past fiscal year. From the standpoint of economic forms the collection is the most comprehensive in the New World and is widely used for reference and identification purposes by plant pathologists and others concerned with economic and other aspects of fungi.

Plant disease reporter. The collection and distribution of current information on plant disease occurrence in the United States, obtained from collaborators serving without pay, has been continued by means of the "Plant Disease Reporter", mimeographed twice a month and sent to about 1,000 plant scientists who have individually renewed their requests for the service. Service work is being continued on the preparation of a check list of diseases of economic plants of the United States for which there is urgent demand. As promptly as possible, sections are issued serially in preliminary form in the "Plant Disease

Reporter". The sections on trees and woody plant have been so issued, and those dealing with grasses, including cereals, are appearing as they can be made ready. All of these activities constitute a service to other Bureau and Departmental agencies and to public and private interests working in fields directly contributory to the war effort.

Ergot of rye. Work with ergot of rye, carried on in cooperation with the Division of Forage Crops and Diseases, indicates considerable variation in the medicinal ergot alkaloid content of different field collections and individual sclerotia. The extent to which this variation is heritable is being tested by cultivating and analyzing progeny from "high" and "low" total alkaloid strains of the ergot fungus.

Rubber investigations: This work on rubber plants is closely integrated with and contributes much information of basic importance to that under the special rubber projects for plantation development in the Western Hemisphere and the emergency production of guayule and other rubber-bearing plants. Data experience are provided for the direction of the special work needed to obtain information for immediate application in the program for large-scale cultivation of guayule and other rubber-bearing plants in the present emergency.

Native or introduced plants as sources of rubber: Wild plants found to contain significant quantities of rubber are given preliminary tests. If they show promise they are studied intensively to determine the best methods of propagation, planting, cultivation, and harvest in relation to yield of rubber as influenced by soil, season, and climate. Improved strains are developed by breeding and selection, and diseases affecting yield of rubber are studied.

Cryptostegia, goldenrod and other promising rubber-bearing plants: On the basis of previous investigations, several species have been recommended for preliminary increase under the Emergency Rubber Project. These include the Madagascar rubber vines (Cryptostegia grandiflora, C. madagascariensis, and an inter-specific hybrid), one species of goldenrod, and the desert milkweeds. Additional strains of these species that promise to be superior to those now available are being tested. Species that are not yet sufficiently proved for the large-scale tests but which have shown appreciable quantities of rubber include many species of milkweed, goldenrod, Indian hemp, rabbit brush, the Colorado rubber weed, the rubber cucumber of Madagascar, the rubber withe of Jamaica, relatives of the Ceara rubber tree of Brazil, the African rubber vine, and dandelion and oyster plant relatives from Russia.

High-yielding strains of goldenrod: Five improved strains of goldenrod were furnished the Forest Service for large-scale tests in 1943. One of these strains is superior to the other strains in leaf yield but ordinarily its rubber content is lower than that of the best strains previously released. In its yield of rubber per acre it is superior to any other strain yet developed.

Cryptostegia: Some success was obtained by the use of growth-promoting substances to induce the rooting of *Cryptostegia* in vegetative propagation, though cuttings that were first ringed and allowed to remain for a month before being cut off did well with or without the use of growth-promoting substances and also gave a quicker response than any other type tested. A new device for collecting latex of *Cryptostegia* was developed and tested. The device consisted of a portable sled with a concave linoleum or oilcloth covering, which is dragged from plant to plant to collect the latex produced by clipping the ends of individual branches.

Rubber production from one-year-old Castilla trees not feasible: Tests of the growth and rubber production of seedlings of the Central American rubber tree, *Castilla elastica*, were made at Coconut Grove, Florida, and compared with material furnished from Mayaguez, Puerto Rico. Results indicated that rubber production from seedlings was not feasible. While this was negative evidence, it was sufficient to convince other agencies that large plantings of *Castilla* for one year production of rubber which were under consideration would not be justified.

Rubber analysis for Governmental agencies and individuals: Four hundred and forty-eight analyses were made of samples of rubber, gums, and plant specimens submitted by other governmental agencies. Three hundred and seventy-nine analyses were made of samples submitted by private individuals either directly or through members of Congress.

The nacta vine for coagulating latex: In cooperation with the Rubber Development Corporation, tests were made of the coagulating power of materials extracted from the nacta vine, *Calonyction aculeatum*. A material having strong coagulating power was isolated and purified. A similar coagulating material was extracted from Jalap powder. Reports on these coagulating substances were furnished the Rubber Development Corporation for use in conducting coagulation tests in Latin America. This was an important contribution to the problem of increasing supplies of wild rubber from Central America. The native industry has depended for many years on fresh extract of the nacta vine for coagulating *Castilla* latex. The vine has been nearly exterminated in the areas where it has been exploited, and the method of extraction developed in this work has shown that a practicable coagulant can be prepared and shipped to producing areas if tests being conducted by technologists of the Rubber Development Corporation indicate the desirability.

Nematology investigations: During the past year, nematode diseases of crops have been on the increase. Various new types of such pests were observed on corn, peanuts, walnut trees, potatoes, and other crops. It is surprising to note repeatedly how growers still ignore this type of crop pest and often search for the cause of their trouble in the wrong direction. Confronted with a nematode disease on his crops, a grower always inquires first of the possibilities of eradicating this pest by a chemical treatment.

Soil fumigants: Although effective soil fumigants against nematodes are available (chloropicrin, carbon bisulfide, methyl bromide, and others), none is satisfactory because of expense, danger in handling, poisonous effects, or other reasons. The search for better nematocides must therefore be continued and must embrace the testing of new chemicals and products offered on the market, sometimes with exorbitant and even false claims. Current tests include such products as "San-Grow", "Cold Smoke Root-knot Control", D-D mixtures, and others. One low-cost chemical has appeared very promising in tests during the 1943 season, giving almost 100% control of the root-knot nematode on the plants tested.

Crop rotation and control: The most practical method to keep ahead of, and control, root-knot and other nematode diseases of plants is by crop rotation. Not infrequently, however, crops that have been resistant in one region or location have proved not to be so in another. Evidence is rapidly increasing that there exist specialized host strains within the root-knot nematode and other plant-nematode pests. Recent investigations have led to the segregation of at least 5 different host strains of the root-knot nematode. In Kern County, California, a cotton strain and an alfalfa strain appear to be mixed.

Use of cover crops in control: The control of root knot in orchards has always been a most difficult problem since rotations in the usual sense are not possible. Experiments carried on at Tifton, Georgia, and extending over a 5-year period have shown that in a peach orchard the root-knot nematode may be controlled to a large extent by the use of highly resistant or immune cover crops, Crotalaria spectabilis in summer and winter oats in winter.

Golden nematode of potato: Further survey work has shown that the golden nematode of potatoes, first observed about 2 years ago on Long Island, has already been considerably extended from the original infestation of about 400 acres near Bethpage. This most serious nematode pest of potatoes of northern Europe is a definite threat to the potato-producing region of Long Island.

Identification work, control recommendations, and information were furnished numerous Federal and State agencies, growers, farmers, and individuals confronted with plant-nematode pests. In cooperation with the Emergency Rubber Project, survey and identification work was continued with rubber-bearing plants such as guayule, kok-saghyz, tau-saghyz, castilla trees, and Hevea trees.

(n) Plant Industry Experiment Farm

Appropriation Act, 1944	\$48,550
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+8,350
Total anticipated available, 1944	56,900
Budget estimate, 1945	56,976
Increase	<u>+76</u>

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Plant Industry Experiment Farm: Maintenance of facilities for basic plant research	\$50,600	\$56,900	\$56,976	\$+76 (1)
Unobligated balance	509	-	-	-
Total available	51,109	56,900	56,976	+76
Anticipated deficiency for overtime pay	-	-8,350	-	-
Total estimate or appropriation	51,109	48,550	56,976	

INCREASE

(1) An increase of \$76 in this item for 1945 for overtime pay required under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$4,482	\$ 195	\$ 210
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	-	8,350	8,426
Total cost of overtime (7 months in 1943).	4,482	8,545	8,636

WORK UNDER THIS APPROPRIATION

This appropriation provides for general maintenance and farm facilities at the Plant Industry Experiment Farm, Beltsville, Maryland. The Acts of October 9, 1940 (54 Stat. 1046) and November 29, 1940 (54 Stat. 1219),

provided for the removal and relocation of the Arlington Experiment Farm, Arlington, Virginia, to the new site at Beltsville, Maryland. This has been accomplished and the Beltsville site is now the headquarters for the Bureau of Plant Industry, Soils, and Agricultural Engineering.

Under this appropriation a service unit is maintained for operation and maintenance of the Plant Industry Experiment Farm, involving such services as operating a central heating plant; maintaining power, water, drainage, gas, sewerage, telephone, and road systems; maintaining a labor force for assignment to research projects and in large part supervising this labor; providing agricultural implements, horses, and equipment, and custodial, mechanical, and guard services; procuring and furnishing supplies and materials; and other operating and service functions. Work done for other branches is performed on a reimbursable basis.

(o) Removal and Reestablishment of Arlington Farm, Virginia (Transfer to Agriculture)

(Allotment to Bureau of Plant Industry, Soils, and Agricultural Engineering)

This budget schedule covers past obligations under the nonrecurring appropriation of \$3,200,000 provided in the First Supplemental Civil Functions Appropriation Act, 1941, as an urgent item in the defense program in order that Arlington Farm might be released in its entirety for military purposes. As indicated under the preceding item for Plant Industry Experiment Farm, the removal and relocation activity has been completed.

(p) Soil and Fertilizer Investigations

Appropriation Act, 1944	\$320,130
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+33,900
Total anticipated available, 1944	354,030
Budget estimate, 1945	346,791
Decrease	-7,239

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Soil improvement and fertilization for crop production	\$150,809	\$161,850	\$154,611	\$-7,239 (1)
2. Fertilizer investigations	182,367	192,180	192,180	- -
Covered into Treasury in accordance with Public Law 674	275	- -	- -	- -
Unobligated balance	3,800	- -	- -	- -
Total available	337,251	354,030	346,791	-7,239

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
Transfer in estimates to				
"Salaries and expenses, library"	+1,680:	- -	- -	
Anticipated deficiency for overtime pay	- -	-33,900:	- -	
Total estimate or ap- propriation	338,931:	320,130:	346,791:	

DECREASE

(1) The decrease of \$7,239 in this item for 1945 will result from completion in 1944 of work on the chemical stabilization of soils for military operations and by suspending for the duration work on thermal properties of soils as related to optimum planting dates for various crops.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$20,220:	\$12,722:	\$12,757.
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	12,000:	33,900:	33,661
Total cost of overtime (7 months in 1943):	20,220:	46,622:	46,418

WORK UNDER THIS APPROPRIATION

Objective: The war has caused drastic changes in the work conducted under this appropriation, and the work has been shifted so as to meet directly war problems, especially those relating to production of food and fibre. The outstanding objectives are: (a) To assist in promoting the most effective use of fertilizer resources in meeting crop production goals; (b) to evaluate new or unfamiliar materials for use as fertilizer and to determine best methods of utilization; and (c) to assist the armed forces in the solution of problems that can be effectively studied with the equipment and personnel of the Division. Other objectives are: (a) To assist in the greater production of food and other war crops by determining the most effective soil management as determined by greenhouse and field experiments performed at several locations differing in soil and climatic conditions; (b) to determine plant food requirements of crops and to assist in obtaining adequate supplies of fertilizers to meet crop

goals; and (c) to determine the inter-relationships of organic matter, soil, micro-organisms, lime, and fertilizers, in developing and maintaining soil fertility.

The Problem and its Significance: War conditions involve many problems in connection with fertilizers and the use of soils. Imports of certain fertilizer materials have been cut off or made difficult. Problems regarding the supply of sulphuric acid have threatened the adequate production of superphosphate. Nitrogen demands for munitions have limited the quantity of nitrogen available for fertilizers. Transportation difficulties have made it necessary to change industrial equipment used in handling shipments and to alter the composition of fertilizer mixtures so as to conserve transportation space. All of these problems caused adjustments which were worked out cooperatively between Government agencies and industry.

Military needs for turf-covered airplane fields and landing strips and for rapid stabilization of soils for emergency use by invasion forces, where mechanized equipment is used, have presented problems involving soil information on turf growing and on the chemical and physical properties required for different uses under varied conditions.

In recent years more than 9,000,000 tons of commercial fertilizer have been used per annum in this country. Continued research on the development of new fertilizer materials, methods of manufacture, and improved methods of fertilization of specific crops on various soils is essential if American farmers are to get the maximum returns for their \$250,000,000 investment in fertilizers. One of the major problems in this field relates to present and post-war utilization, for fertilizer purposes, of the synthetic ammonia or derived products available from war plants. These plants, some ten in number, are now making available in part their production for nitrogen fertilizers. Their proper utilization will require a great deal of research in both the production and use of nitrogen fertilizers.

Results of studies in soil chemistry, physics, and microbiology are essential to the interpretation of results observed in field experiments and on the farm, to the development of improved conservation-cultural practices, and to a better understanding of factors influencing the efficiency of fertilizers and soil management practices.

General Plan: War problems are given first place in the utilization of equipment and personnel. Fortunately, the basic research of the Bureau in past years has been very useful to several of the war agencies, particularly those concerned with food production. Such material has been presented in special reports to the proper authorities. In several instances members of the Division have made special studies and reports for war agencies.

Investigations relating to fertilizers, soil improvement and fertilization of crop production are being closely correlated with the work of State agricultural experiment stations. Thus, as a new fertilizer is developed, it is tested at several State agricultural experiment stations as well as at the Bureau's Beltsville Station. A similar procedure is followed in soil-management studies.

Examples of Progress and Current Program:

Soil Improvement and Fertilization for Crop Production:

Soil fertility and fertilizer uses in cropping systems. Investigations of soil-management practices, designed to increase soil fertility and improve the quality and yield of crops, have included: (a) Field experiments in which the effects of various soil-management practices on crop yields and quality are determined, and (b) related studies under controlled laboratory and greenhouse conditions on the properties of soils and environmental factors influencing crop yields and quality. The field experiments are performed partly at Beltsville, Maryland, but mostly under cooperative agreements with State experiment stations. Cooperative work in New England deals with the fertility requirements of potatoes; in South Carolina with the value of cover crops and legumes as supplements to fertilizers for cotton on sandy soils; in North Carolina with the proper use of green manures, cover crops, crop rotation and fertilizers in improving corn production. Additional field work is performed in cooperation with the Division of Forage Crops and Diseases, Dry Land Agriculture, and Irrigation Agriculture to improve production of various crops grown on markedly different soils and under varied conditions.

Soil-fertilizer chemistry as related to plant nutrition. All soils tend in varying degree to fix added fertilizer nutrients in forms unavailable to crops. Methods for avoiding or delaying such fixation are necessary for maximum crop response. In studies cooperative with the Division of Forage Crops and Diseases, it was found that by applying fertilizer in bands the solubility of the phosphorus remained high for 11 months, whereas when the fertilizer was broadcasted and mixed with the soil the solubility of the phosphorus was quickly reduced. Band application proved notably superior to broadcast application for Sudan grass on two soils varying widely in texture. Such findings make possible increased economy and profit to the farmer using fertilizers.

Minor elements in nutrition of plants. Numerous situations have been observed in which crop yields have been limited by inadequate supplies of essential minor elements. Chemical inventories of the total supplies of these minor elements in important agricultural soils are under way. Coastal plain soils have been found generally poorly supplied with copper and zinc with little variation in content from the surface to lower depths. In contrast, these elements are found to be relatively abundant in Midwestern soils with frequently considerable variation at different depths.

Chemical analyses made in connection with the Special Guayule Project have shown that guayule contains relatively large amounts of boron, sulfur, chlorine, and calcium compared to most other crops. The opposite is true for manganese and phosphorus. These facts have important implications relative to the soil and fertilizer requirements of the guayule crop.

Recent analyses of crop plants show the presence of the rare earth elements in amounts from 10 to 100 parts per million. Although little is known regarding the importance of the rare earths in plant nutrition, it is quite possible that some of them perform important functions in plant growth. Studies to determine this are planned.

Organic matter in soil improvement. Additions of active organic matter to soils in the form of crop residues, green manures, animal manures, and composts may be highly effective in improving crop yields and reducing soil erosion. However, depending upon the kind of organic matter and the time and method of incorporation, these effects may range from highly beneficial to definitely harmful. Studies are being made of the chemical changes produced by soil-micro-organisms in the decomposition of different kinds of organic matter and of the effects of these changes upon the availability of plant nutrients and upon physical soil properties. These studies include the effects of organic residues returned to the soil under different cropping systems. In related studies it has been found that cotton root rot can be controlled by proper use of green manures and the application of this method to other soil-borne diseases is being investigated.

Nitrogen fixation by legume bacteria. Inoculating legume seed with strains of nitrogen-fixing bacteria adapted to the particular legume species is a well-established practice. The preparation and sale of cultures of these bacteria is carried on by a considerable number of commercial companies. In general these cultures are of good quality and result in good inoculation. Some are of inferior quality because of carelessness or ignorance of proper methods on the part of the manufacturer. During each of the last several years from 400 to 500 samples of commercial inoculants have, therefore, been tested to furnish reliable information to the farmer. Inoculants are purchased on the open market and tested in the greenhouse and field, work requiring high technical skill to prevent contamination. Information permitting the use of only high quality inoculants is of special importance in obtaining high yields of peanuts, soybeans, and other legume and oil crops needed in the emergency.

Fertilizer investigations:

Nitrogen fertilizers. Owing to the great demand for nitrogen for high explosives and other war industries and to difficulties of importing nitrate from Chile, supplies have been inadequate to fully meet the increased demands for fertilizer purposes. In spite of this, the actual consumption of nitrogen as fertilizer in the United States last year was the highest on record. Tests made of the value and methods for using

certain nitrogenous war factory byproducts resulted in the addition of several thousand tons to the nitrogen available for agricultural use.

While the shortage of nitrogen will probably not extend beyond the present year, it will still be necessary to continue the allocation of nitrogen to insure its equitable distribution. The Bureau has furnished counsel and advice, assisting in arriving at equitable allotments for crops grown under wartime conditions.

Use of ammonium nitrate. The release of surplus nitrogen as ammonium nitrate from munitions plants by the Ordnance Division of the U. S. Army and by Canadian officials insures adequate supplies of nitrogen as fertilizer for next season. While ammonium nitrate has long been used in a less concentrated form, its use in highly concentrated form has presented problems new to the industry regarding its utilization both for direct application and in mixed fertilizer. The Bureau has taken the lead in the treatment of the solid material and in the formulation of mixed fertilizer to permit full utilization of ammonium nitrate in both fields, and has coordinated the efforts of those engaged in similar investigations so that full benefit of the results will be transmitted to fertilizer processors, distributors, and consumers. In a few months the information made available has changed the picture from one of consternation by the industry at the prospect of utilizing an unfamiliar material with reputedly undesirable properties to one of confidence in adapting a material, formerly used sparingly, to large usage in every category where fertilizer nitrogen is needed.

The problems arising because of the tendency of ammonium nitrate to absorb moisture rapidly even to the point of solution and to cake badly in storage were vigorously attacked in cooperation with manufacturers in this country and in Canada, and with other Government agencies. The information acquired has shown how to reduce the rate of moisture absorption, protect the treated material from atmospheric moisture through the use of moisture-resistant containers, formulate mixed fertilizers containing additions of ammonium nitrate as solid or as solution, alleviate caking tendency, and how to establish safety limitations in handling and storing. This makes possible the use of low-cost nitrogen from munitions plants, relieving shortage conditions and insuring greater production of crops vital in the prosecution of the war.

Limits for ammoniation of superphosphate determined. The rapid development of ammoniation of superphosphate in the United States has furnished an opportunity for greater utilization of low-cost synthetic ammonia in mixed fertilizer. A large portion of the ammonium nitrate being released for use in fertilizer will be used as nitrogen solutions for ammoniation of superphosphate, and the cost of this nitrogen is likely to decrease still further after the war. It is of great economic importance to determine the limits for use of such solutions before the phosphorus availability to plants is seriously impaired. Results from greenhouse experiments, made at several State experiment stations using specially

prepared ammoniated materials, all agree that mixtures with added ammonia amounting to as much as 5% of the superphosphate are less effective in promoting plant growth than those ammoniated at lower rates. Ammoniation to 4% produces no serious decrease in phosphorus availability, if other conditions are not favorable to reversion of phosphate to unavailable forms. The use of 1% more nitrogen of this low-cost material in 5,000,000 tons of mixed fertilizer will amount to an annual saving to the farmer of \$61.00 per ton on 50,000 tons of nitrogen or approximately \$3,000,000. This result is not an unreasonable expectation.

Mixed fertilizers. Problems in formulation of mixed fertilizer have arisen because of shortage of nitrogen, threatened shortage of potash, avoidance of reduced superphosphate production by failure of sulphuric acid supply, and demands for higher analysis goods to reduce the strain on overburdened transportation facilities. Along with these changes greater proportions of soluble fertilizer salts are employed in mixed fertilizers. This higher salt content requires greater care in the placement of such mixed fertilizers in order to avoid seed injuries that prevent germination and plant injuries that cause burning. A study has been made of the osmotic pressures of the soil solution where mixed fertilizers of known compositions are used and of the solution from sodium nitrate as a reference material. The salt index obtained by this comparison gave a satisfactory method for measuring the relative burning tendency of a fertilizer. It is possible to calculate the salt index of a mixed fertilizer from the indexes of the materials used in the mixture. Thus, in advance, the burning tendency of a fertilizer can be determined and its use or placement prescribed in a manner to avoid injurious effects. Vegetative tests in field and greenhouse have indicated that the salt index is a reliable guide to the injury possibilities of a fertilizer.

Turf maintenance. One of the most interesting of the emergency wartime problems that has been presented this year is that of turf maintenance on air fields and emergency landing strips, carried on in cooperation with the Division of Forage Crops and Diseases and war and highway agencies interested in the problem, both from the standpoints of war necessity and peacetime use. The problem involves a variety of turfs grown on soils with great differences in composition and structure. Turf coverage is highly important in making difficult the identification from the air of air fields and emergency landing strips. Test plots were constructed at Beltsville with mixtures composing the subsurfaces made of gravel, crushed rock, and limestone with various soil toppings, to determine the relative values of such mixtures for growth of turf and for bearing strength necessary to withstand emergency landings. Results obtained, including determination of physical properties of several different soils, have been used by Army Air Forces for extending airport runways in the Pacific Northwest.

Fire retardants on turf. A corollary of the turf problem was the study of fire retardants for treatment of dried grass on air fields or at military installations, such as occurs in large areas of the West under

arid or semiarid conditions. Laboratory work soon indicated that dry grass could be treated by spraying with chemicals that would afford protection against fire under certain conditions of use. During the summer, field demonstrations were made at several locations in Oklahoma and northwestern States for the benefit of the Army, the Navy, and the Public Roads Administration. Strips or squares of grass treated with chemicals of necessary strength were found to serve as excellent firebreaks under severe conditions of fire, approaching from one or several directions, with and against the wind. So successful were the demonstrations that instructions for use of the retardants have been issued by the U. S. Army Corps of Engineers in a descriptive circular illustrated with photographs of the strips and areas tested. Not only is it of importance for air fields and military installations for fire protection, but it has possibilities in camouflaging such areas.

Byproduct sulphuric acid. Because of the great demands for sulphuric acid in the manufacture of explosives, there appeared a likelihood of a shortage of this acid for the production of superphosphate so important in fertilizer manufacture. In order to supplement the supply with byproduct acid, it was necessary to establish its suitability for this use. Superphosphates were prepared with the usual acid and with byproduct acid, and were used for fertilizing crops, both in the greenhouse and in the field. The results were conclusive that the superphosphate from the byproduct acid was equal in crop producing value to the regular superphosphate, and there were no evidences of toxic material from the use of such superphosphate in usual rates of applications.

Other related war activities. Data have been, and are being, assembled to furnish the Board of Economic Warfare and the Tariff Commission information on fertilizer resources of Axis Countries.

Phosphate requirements of Western States. A report on the phosphate requirements of Western States in the Pacific Coast and Intermountain areas was prepared for the War Production Board.

Phosphates for livestock feed. The need for phosphate in feeds has required a special survey of the available sources to determine suitable materials low in fluorine that may be used in livestock feeds. The information has been supplied to the Food Production Administration, the Combined Food Board, the War Production Board, the Bureau of Animal Industry, and interested commercial agencies.

Fertilizer consumption survey. A completed survey of the fertilizer situation in 1941 showed that year to have the highest fertilizer consumption of any recorded--9,284,000 tons, containing 453,000 tons of nitrogen, 985,000 tons of phosphoric acid, and 451,000 tons of potash.

(q) Soil Survey

Appropriation Act, 1944	\$149,595
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+24,856
Total anticipated available, 1944	174,451
Budget estimate, 1945	174,582
Increase	+131

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Investigations, classification, and mapping of soils:				
(a) Investigation, classification, and mapping of soils in the field.	\$ 78,265	\$ 76,033	\$ 76,033	- -
(b) Field inspection of soil surveys and correlation of soil types and series	71,800	39,598	39,598	- -
(c) Adjusting, constructing, and drafting soil maps and charts for reproduction	52,888	58,820	58,951	+\$131 (1)
Unobligated balance	5,477	-	-	-
Total available	208,430	174,451	174,582	+131
Anticipated deficiency for overtime pay	-	-24,856	-	-
Total estimate or appropriation	208,430	149,595	174,582	

INCREASE

(1) An increase of \$131 in this item for 1945 for overtime pay required under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$11,878	\$ 1,257	\$ 1,257
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	3,000	24,856	24,987
Total cost of overtime (7 months in 1943)	14,878	26,113	26,244

*Difference between overtime cost and supplemental appropriation,

WORK UNDER THIS APPROPRIATION

Objective: To provide accurate, detailed information for increasing the efficiency of crop production and for developing improved farm programs--information that will be published and readily available to farmers, farm associations, State and Federal agencies, and others concerned with the best use of rural lands. This involves the classification of soils in a national system on the basis of field and laboratory investigations; the indication of their extent and distribution upon maps; the explanation of their possibilities for producing adapted crops, grasses, and trees, in terms of yield and management requirements; and recommendations for their stability and conservation under alternative systems of farm management. During wartime, special emphasis is given to determining the suitability, location, and management requirements of soil for crops vitally needed in the war effort--crops such as hemp, peanuts, castor beans, rubber plants, and others; that must be put on suitable types of soil if production goals are to be attained--and to provide soil maps and related findings that are needed in the food production program and other war projects.

The Problem and its Significance: By relating the experience of farmers and the results of agricultural research to definite soil types, individual farmers apply the information to the particular soil types on their own farms. There are several thousand soil types in the United States, different from one another in a few or in all of their important characteristics that determine their usefulness for various crops, pastures, or trees. Soils also vary in their response to cultural practices. Methods of soil management that lead to high production and soil conservation on one soil type may be less useful, or even ruinous, on another. Some soils are benefited by terracing, others are not; some are acid and respond to liming, others do not; some in dry regions can be irrigated successfully, others cannot be; some are very susceptible to blowing or washing, others are not. The crops, or varieties of crops, that can be grown with success, the needs for fertilizers to produce good yields of crops high in quality and nutritional values, and the effectiveness of various tillage methods are all different on different soil types.

War crops, like hemp, peanuts, castor beans, and guayule and the other rubber plants, have their own special soil requirements for economical and efficient production. Proper groupings of soil types and special interpretations of soil maps, or even special maps in some cases, are essential to rapid and dependable expansion of crops vital to the war effort.

The main problem of the Soil Survey is to maintain a system of classification that can be used by all agricultural technicians and agencies. In constructing maps of soil types and developing descriptions and ratings of soil types, it is of basic importance to use standard terms and symbols so that significant differences are understood clearly and definitely as they apply to individual fields and farms, and to particular crop production problems. The system of classification must be carefully

coordinated on a national basis, in cooperation with the State agricultural experiment stations, so that similar soil types are everywhere given the same names and definitions. Standards of soil nomenclature, definition, and classification are essential to the successful conduct and application of agricultural research.

The drastic crop adjustments called for in the present emergency can be made quickly and effectively only on the basis of an accurate knowledge of the soil conditions. Accurate soil maps are extensively used as factual guides in the agricultural programs of the State governments, the Department of Agriculture, the Tennessee Valley Authority, and other agencies. Farmers, prospective farmers, and especially county agricultural agents, use these maps in order to make use of the results of agricultural research as applied to specific fields.

General Plan: The Soil Survey is conducted cooperatively with the appropriate State agencies, especially the State agricultural experiment stations, and with the Soil Conservation Service, the Tennessee Valley Authority, and other Federal agencies. At least some work has been done in every State and Territory, but more has been done in those States making large financial contributions toward the work. Active work has been under way recently, for at least a part of the year, in 30 to 35 States. (Many of the scientists in the Soil Survey are now assigned to special projects dealing with the expansion of war crops, and the cooperative soil-mapping work with the State agricultural experiment stations is continuing at a reduced rate).

Scientists of the Bureau cooperate with other public agencies, including the Bureau of Agricultural Economics, the Farm Credit Administration, the Soil Conservation Service, the Farm Security Administration, the Tennessee Valley Authority, the Forest Service, the Bureau of Reclamation, and the Bureau of Indian Affairs in developing agricultural and land programs that involve needs for a knowledge of soil and for the interpretation of soil maps and other soil research.

Under the present emergency, scientists of the Bureau are making soil surveys only in areas of special significance to the war. A large part of the survey force is necessarily engaged upon special surveys and investigations to determine where vital war crops may be extended most economically and quickly.

For effectiveness, soil survey work is coordinated on a national basis so that similar soils are everywhere given the same names and descriptions in all States. At the same time, the State scientists contribute their detailed local experience. This cooperative basis makes it possible to have the benefits of both local and national experience and to develop a common nomenclature that fits local conditions.

The Division of Soil Survey not only sees that soil types are accurately and uniformly defined and mapped but also cooperates with other divisions of the Bureau in coordinating the results of other plant and soil

research with the findings regarding soil types and soil groups recognized in the system of classification. It is through the medium of soil classification and soil maps that much of the Bureau's work finds application to specific fields, farms, and rural communities.

Examples of Progress and Current Program: Soil maps and the published information that accompanies them are being widely and intensively used in current agricultural programs. In cooperation with Federal and State scientists and program administrators, the soil scientists are not only continuing their investigations but are also interpreting soil maps and descriptions in relation to other research, particularly as applied to the problems of wartime agriculture. Soil scientists are thus helping the establishment of war-crop goals and in the delineation of areas for the expansion of individual crops. They are likewise making recommendations for management practices on individual soil types and are helping to give guidance to various programs for agricultural adjustment. Basic soil data are also being called for in planning collaborative agricultural programs in other countries, more especially in Latin America.

Special war crops. Particular attention is being given to the soil requirements of new crops or those needing great expansion on account of the war emergency, and to the selection of soil types and areas where these may be grown with maximum production for the land, labor, seed, machinery, and materials used.

Guayule. Soil types have, for example, been grouped according to their suitability for guayule rubber production. General surveys were made to locate promising areas for operations. Detailed surveys of individual tracts were later made to determine their suitability for guayule and to provide aids in leasing lands and in planning operations.

Hemp. General soil regions suitable for hemp production were designated for use in the selection of hemp mill sites by War Hemp Industries, Inc., in charge of national hemp production. In cooperation with the interested State experiment stations information on the soil requirements of hemp and the suitability of specific soil types for the crop was developed and made available to farmers. Also experimental plots have been selected and more precise data are being obtained during the current year regarding the relative suitability and productivity of individual soil types for hemp.

Peanuts. Field studies are being carried on in the southeastern States in cooperation with the State experiment stations and other scientists of the Department, to determine the relative suitability of soil types for peanuts and to indicate where the crop can be most effectively expanded. Preliminary results show that a greatly expanded acreage of peanuts is feasible in some counties, as far as suitable soil is concerned, whereas in other counties nearly all suitable soils are already being used for peanuts. The results have been assembled in map form for Georgia, and work is progressing in the other parts of the region.

Castor Beans. Field studies are in progress in the South Central States where castor beans were produced last year in order to group soil types according to their suitability for this crop. These results are being prepared in map form and the observations extended to adjacent areas of promise.

Wartime production capacity. Soil scientists have been and are now working with others in the Bureau of Agricultural Economics, the War Food Administration, and the State experiment stations in appraising maximum wartime production capacity. Such an appraisal involves the soil requirements of specific crops, the suitability of the various soil types for use, and the management requirements for maximum production consistent with conservation and the available supplies of land, labor, and materials, and the interpretation of soil maps and other soil data has been found to be of basic importance.

Soils inspection and classification. All surveys made by the Department that involve the mapping definition, or nomenclature of soil types or groups, or that deal with soil characteristics and use, are inspected by the scientists of the Soil Survey. This results in effective administration and conduct of the work in that all mapping done by the Department will fulfill the immediate needs of agricultural production and conservation programs most effectively as well as contribute to the soil survey of the whole country, basic to all agricultural programs. About 900 mapping projects of the Department are being inspected and the soils studied and classified.

Field mapping of soils: Except in a few critical areas where soil information is needed for war crops, scientists of the Soil Survey have suspended field mapping during the war emergency. In many States, however, field surveys are regarded as critically necessary and are being conducted by State employees. These are inspected by our staff and are considered a part of the Department's longtime program. During the fiscal year ending June 30, 1943, 5,759 square miles of detailed soil mapping and 1,729 square miles of reconnaissance mapping were completed in various parts of the country. The larger part of this total area was mapped by State employees on cooperative projects.

Soil surveys released. During the fiscal year ending June 30, 1943, soil surveys of 16 areas, mostly counties, were released by the Government Printer, as follows:

California:	Pixley Area	Oklahoma:	Tulsa County
	Wasco Area	Rhode Island:	Newport & Bristol Cos.
Georgia:	Dade County		Providence County
Indiana:	Knox County	S. Carolina:	Pickens County
Michigan:	Clinton County		Sumter County
New York:	Albany & Schenectady	Tennessee:	Roane County
	Cos.	Utah-Ariz:	Virgin River Valley
	Seneca County		Area
N. Carolina:	Madison County		
	Warren County		

Soil surveys in Printer's hands: On July 1, 1943, 39 soil survey reports, exclusive of reprints, were in the hands of the Government Printer, as follows:

Alabama:	Macon County	New York:	Sullivan County
California:	Bakersfield Area	North Carolina:	Henderson County
	Kings County	North Dakota:	Billings County
	Santa Cruz Area		Morton County
	Tracey Area	Ohio:	Lucas County
Idaho:	Blackfoot-Aberdeen	Oklahoma:	Choctaw County
	Area	Oregon:	Umatilla Area
Indiana:	Bartholomew County	Pennsylvania:	Bucks County
	Brown County		Huntingdon County
	Fulton County	Tennessee:	Hamblen County
	LaPorte County		Humphreys County
	Martin County		Lincoln County
	Vanderburgh County		Rhea County
Kentucky:	Calloway County	Texas:	Dimmit County
Mississippi:	Tishomingo County		Fannin County
Missouri:	Linn County	Utah:	Salt Lake Area
Montana:	Big Horn Valley Area	Virginia:	Russell County
	Upper Musselshell		Washington County
	Valley Area	Washington:	Kittitas County
New Hampshire:	Cheshire & Sullivan		Snohomish County
	Cos.		
	Coos County		

(r) Salaries and Expenses, Soil Conservation Service

(Allotment to Bureau of Plant Industry, Soils, and Agricultural Engineering)

This budget schedule covers obligations under an allotment for inspection and correlation of surveys made by the Soil Conservation Service, as mentioned under the preceding item for "Soil Survey."

(s) Sugar-plant Investigations

Appropriation Act, 1944	\$350,340
Anticipated deficiency for overtime pay required by the War	
Overtime Pay Act of 1943	+45,200
Total anticipated available, 1944	395,540
Budget estimate, 1945	370,000
Decrease	<u>-25,540</u>

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. Sugar-plant production, breeding, disease, and quality investigations:				
(a) Sugar beets	\$202,999:	\$214,124:	\$199,534:	\$-14,590 (1)
(b) Sugarcane	130,700:	138,587:	127,637:	-10,950 (2)
(c) Sugar sorghums	28,303:	42,829:	42,829:	- -
Covered into Treasury in ac- cordance with Public Law 674	945:	- -	- -	- -
Unobligated balance	6,778:	- -	- -	- -
Total available	369,725:	395,540:	370,000:	-25,540
Transferred to "Salaries and expenses, Office of Administrator, Agricultural Research Administration" .	+1,500:	- -	- -	
Anticipated deficiency in overtime pay	- -	-45,200:	- -	
Total estimate or ap- propriation	371,225:	350,340:	370,000:	

DECREASES

The decrease of \$25,540 in this item for 1945 consists of:

(1) A decrease of \$14,590 by curtailment of work on improved cultural practices for sugar beets in Colorado; on curly-top control in California; on sugar-beet seed production in Utah; on breeding for leaf-spot resistance at Beltsville, Maryland; and discontinuance of work in Ohio on sugar-beet production and disease control.

(2) A decrease of \$10,950 by curtailment of work on fertilizer practices for sugarcane in Louisiana and on sugarcane variety testing in Louisiana and breeding in Florida; discontinuance of sugarcane breeding work in the Canal Zone; and curtailment of work at Beltsville, Maryland.

The distribution of the decrease by locations is as follows:

California, Riverside	\$3,702	Ohio, Wooster	\$2,160
Colorado, Fort Collins	1,970	Utah, Salt Lake City.	2,555
Florida, Canal Point	1,367	Canal Zone	3,414
Louisiana, Houma	3,738		25,540
Maryland, Beltsville	6,634		

Statement of Overtime Costs

	: 1943	: Est. 1944:	Est. 1945
Overtime absorbed	: \$24,232:	\$ 5,593:	\$ 5,383
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	: - - :	45,200:	42,730
Total cost of overtime (7 months in 1943) :	24,232:	50,793:	48,113

WORK UNDER THIS APPROPRIATION

Objective: To meet national wartime needs for sugar by increased production of sugar crops in United States despite shortages in farm labor, machinery, fertilizers, and other supplies, by means of: (a) Improved agricultural practices to obtain better and more uniform stands, to reduce the labor requirements for thinning, weeding, and harvesting, and to increase the efficiency of fertilizer use; (b) the increase and distribution for widespread use by growers of new and improved disease-resistant varieties of sugar beets, sugarcane, and sugar sorghum to prevent losses from disease and other controllable hazards; and (c) insuring adequate supplies of domestically grown sugar-beet seed and of seed cane of improved varieties.

The Problem and its Significance: Under continued stress of war conditions, domestic production of sugar from sugar beets and sugarcane, and production of sirups from sugarcane and sugar sorghums have especial significance. Sugar was the first foodstuff rationed when importations normally supplying 70% of our requirements were drastically reduced because of conditions affecting maritime shipments. Increased demands have come for sugar for the Armed Services and for Lend-Lease. Even with a somewhat improved outlook for transport of off-shore sugar, domestic production should continue to make its large contribution to the Nation's sugar supply.

The sugar crops of the United States represent an investment in farm and factory facilities of more than three-quarters of a billion dollars. Investments in subsidiary industries furnishing supplies and in livestock industries utilizing byproducts increase the total to approximately a billion dollars.

In 1942, the acreages in sugar plants approached the largest in our history. Sugar beets for sugar were planted on 1,061,000 acres. In spite of a goal set in 1943 for 1,050,000 acres, the 1943 acreage is the smallest in two decades. Sugar production will be correspondingly low, throwing out of balance strategic estimates as to home-front contribution. Sugar beet seed acreages in 1942-43 season, the largest in history, may be reduced 20% to 30% in 1943-1944. In the southern States,

301,000 sugarcane acres were planted in 1942 for sugar, 125,000 for sirup, and about 30,000 for seed cane. The 1943 acres for both sugar and sirup have been well maintained in face of stupendous labor problems. Sugar sorghum for sirup production continued to occupy in 1943 well over 230,000 acres in 18 States.

The 1943 sugar beet-crop has experienced a 40% decrease in acreage below the national goal as established in November 1942. Nearly one-fourth of the beet sugar factories will not operate in 1943. Under the circumstances surrounding the crop, probably the greatest factor in the reduced acreages of 1943 and the consequent enforced closing of factories, was fear upon the part of farmers that labor to care for the crop would be insufficient. Sugar-beet acreage has been planted to other crops demanding less hand labor. Labor-saving methods for growing sugar beets, as available, were too new, and adequate experience was lacking as to results to be expected from the new operations. Whether the sugar-beet industry shall contribute to its fullest extent to the war effort in producing its goal of domestic sugar or whether it shall make a lesser contribution, depends, in a large part, on the speed that can be made in meeting labor shortages by mechanized operations.

The crisis in the sugar-beet industry and the sharply increased difficulties in growing the sugarcane crop under the impact of war conditions emphasize the importance of research to discover new short cuts, to introduce, test, and appraise labor-saving methods, and to obtain more efficient fertilizer use; furthermore, it is the task of research to maintain the flow of improved, dependable, and disease-safe varieties for the farmer to grow.

Production costs with sugar crops are relatively high, because labor requirements are large. This labor must be expended on the most productive type of plant. Unfavorable seasonal or disease conditions may make the crop of a district unprofitable or marginal. Early freezes may catch much of the Louisiana sugarcane crop, either causing outright destruction of standing cane or deterioration of its value by spoilage. The breeding programs aimed to produce disease-resistant types of both sugar beets and sugarcane, and cold-tolerant types of sugarcane, are essential elements for continuance in peacetime of the sugar industries. Under war conditions, with greatest production demanded from each acre, there is augmented responsibility upon applied research. At this time, the Nation cannot afford any preventable losses in the field or wastes in production. Hence as every effort is made to improve methods of culture and meet labor shortages, there must be no let-up in those phases of productive research that supply the industry with disease- and weather-safe varieties to grow.

General Plan: The work is organized under three headings (a) sugar beets, (b) sugarcane, and (c) sugar sorghums. Sugar-beet investigations, in large part conducted in cooperation with State agricultural experiment stations, are carried on near centers of sugar-beet production at East Lansing, Michigan; Wooster and Holgate, Ohio; St. Paul, Minnesota; Scottsbluff, Nebraska; Fort Collins, Colorado; State College, New Mexico; Salt

Lake City, Utah; Twin Falls, Idaho; Riverside, California; and Corvallis, Oregon. Intensive improvement investigations, previously at Arlington Farm, are conducted at Beltsville, Maryland.

Sugarcane investigations are conducted at Canal Point, Florida; Houma, Louisiana; Cairo, Georgia; Meridian, Mississippi; Summit, Panama Canal Zone; and Beltsville, Maryland.

Sugar-sorghum investigations are conducted chiefly in the southern states, with some work in Iowa, Minnesota, Nebraska, Utah, and California.

Examples of Progress and Current Program:

Sugar-beet production, breeding, disease, and quality investigations: While total production of sugar beets in 1943 will be proportionately less by the 400,000-acre decrease below the 1942 acreage, sugar-beet fields carried through to harvest give promise of maintaining normal yields because of characteristics of the varieties grown and the assistance given by scientific research on short-cut methods of growing the crop in face of shortages of labor and supplies. Retention of from one-quarter to one third of the 640,000 acres planted in 1943 can fairly be credited to the new technique, sheared seed, introduced as an emergency measure for the 1943 crop. Many sugar-beet growers, anticipating insufficient hand labor to care for the crop, made the choice of trial of this new, labor-saving method rather than to give up the crop. In irrigated districts, the results from sheared seed have, in large measure, come up to expectations; trials in the humid area have been disappointing. The wide-scale trials of sheared seed have revealed many problems that must be solved before this technique in crop growing attains a full degree of efficiency and safety. The handicaps of the method that come from improper shearing of the whole seed to single-seed units, from improper planting rates that tend to nullify its advantages, and from drilling sheared seed at improper depths, must be removed. Further investigations are necessary to make this new technique thoroughly effective. Technologists of the beet-sugar industry and agricultural specialists agree that the sugar-beet industry is on the brink of revolutionary change in methods of growing and harvesting. The industry, to survive, must, in large measure, be prepared to change from intensive, hand-labor methods--essentially market-garden operations--to nearly complete mechanization. Whether the transition follows a haphazard course of trial and error or registers a rapid, forward advance depends upon the development by research of basic information on proper methods of mechanized operations.

It has been determined that sugar-beet seed can be produced in the Pacific Northwest without irrigation, by early planting to take advantage of moisture from winter and spring rains. This new practice opens new areas for greatly needed expansion of the seed enterprise.

Breeding investigations with sugar beets must continue to supply the essential foundation stocks of improved varieties for use by American

growers. These superior varieties are characterized by adaptation to local requirements, especially in resistance to disease. As a result of the investigations in this project growers of sugar beets now have available to them better adapted varieties than ever before. The breeding investigations closely interlock with seed production. The sugar-beet seed enterprise as conducted by beet-sugar companies functions to increase for growers' use the best sorts as produced by plant breeders. By close coordination of activities, as soon as the new variety is obtained and adequately tested, it is immediately multiplied to furnish seed in commercial quantities.

Leaf spot, root rots, and curly top are highly important sugar-beet diseases. If uncontrolled, they seriously limit production. Very definite advance is being made in obtaining varieties highly resistant to leaf spot and curly top, and general control measures greatly alleviating root rots are under extensive test. The new leaf-spot resistant variety U. S. 215 X 216 developed by these investigations was used to plant approximately half of the acreage of sugar beets grown in the humid area. In comparative tests conducted in Colorado, Wyoming, Nebraska, Minnesota, Wisconsin, Indiana, and Michigan, where leaf spot is serious, U. S. 215 X 216, as the average of 26 trials in 1941, and as the average of 19 trials in 1942, showed nearly 10% superiority in acre-yield of sugar over European types formerly used. Through further breeding, a new superior strain "Improved U. S. 215 X 216" has been developed, and seed is being increased for release to growers. Curly-top resistance of the recently introduced variety, Improved U. S. 22, is highest yet achieved, the outstanding yielding capacities of its parent variety, U. S. 22, being maintained. Plantings in Idaho, Utah, Oregon, Washington, western Colorado, and late plantings in California in 1943 utilize to a large extent the new variety.

Because of the strong resistance to curly top achieved by such varieties as U. S. 22 and Improved U. S. 22, sugar-beet growers in districts subject to severe curly-top exposure plant their crop confident that this virus disease will not cause crop failure. Losses from the disease still occur even with highly resistant varieties, but an almost revolutionary change from the former record of crop failure and abandonment has been accomplished by continued breeding work.

Investigations on root rots and attendant seedling diseases give promise of alleviating the threatening situation occasioned by these soil-inhabiting plant pathogens. No highly resistant types have as yet been found, hence recourse to general control measures including proper crop sequence, soil preparation, and fertilization practice is necessary. An outstanding accomplishment of these investigations is the proof that incidence of disease is closely correlated with deficiencies of available phosphate. Heavy applications of phosphate have improved stands and reduced root rot. The root-rotting diseases of sugar beets are a prime factor barring introduction of sheared seed in the humid area where seedling diseases and root rots are serious. Investigations now in

progress center on discovery of ways and means to obtain adequate stands with the sheared seed. Utilization of this labor-saving method in the more eastern district depends in large measure on the outcome of this research.

Sugarcane production, breeding, disease, and quality investigations:

The Bureau's sugarcane program is centered on the increase and introduction of new, disease-resistant varieties of sugarcane capable of producing more total sugar; improved means for controlling those diseases that significantly reduce yields; determination of nitrogen requirements for optimum cane yields, without recession in quality; and means for reducing losses of sugar in frost-injured cane, commonly occurring late in the harvest season, and occasionally extremely serious if freezes occur by mid-November or earlier.

Seed cane of the new, improved variety C. P. 34/120, introduced in 1942, will be ample for extensive plantings for 1943-44 season. This variety is of especial value in many sections of Louisiana because when windrowed it loses very little of its value for cane sugar. Two new mosaic-resistant varieties, C. P. 33/310 and C. P. 33/425, characterized as having special adaptation to certain soil types and adapted to machine harvesting, were released in 1943, and soon will take their place among other valuable varieties developed by these investigations. A survey made in 1942 revealed that 53% of all sugarcane grown in the Sugar Belt are of varieties developed by these investigations, the remaining 47% being grown with varieties introduced by this Bureau after tests proved their adaptability.

Agronomic investigations have centered on improved farm practices, special consideration being given to weed control, a problem made exceedingly pressing in light of current labor shortages. Some advance has been made by cleaning up weeds on ditch and bayou banks, thereby reducing the fouling of fields. Flaming shows promise for control of yield-reducing perennial weeds. Recently introduced weeds, Johnson Grass and Alligator Weed, have now become established and in seriousness outrank other weeds. Weed control has now become a major problem in sugarcane growing.

Sugar sorghum production, breeding, disease, and quality investigations:

This work, begun July 1, 1941, is directed toward development of sorghum as a supplementary source of domestically produced sugar. The objectives of the program are the breeding and development of high-yielding, high-quality varieties of sugar sorghum adapted for sugar production under soil and climatic conditions of the United States, and discovery of efficient methods of culture and disease control. Obvious advantages will accrue if sorghum can be so bred as to become an efficient sugar plant and can be grown as a supplementary early-season crop milled in existing factories in advance of the regular cane and beet campaigns. Objectives in this research include an extension of the period of employment of farm labor, thus smoothing out peaks of labor demand in the sugarcane belt, an extension of the profitable utilization of sugarcane mills and possibly

beet-sugar factories also in certain districts, where equipment valued at 200 million dollars is now used in campaigns of 75 to 100 days per year, and a corresponding extension of profitable employment of factory and transport labor.

The problem faced with this sorghum plant is increase in acre-yield of cane without reduction of sugar quality. Sugar sorghums now existent in United States are properly classified as sirup sorghums. They have requisite sucrose content, but many are undesirably high in starch and high in dextrose. None of these give adequate acre-yields of cane for economic production of sugar in comparison with the highly bred sugarcane or sugar-beet varieties. From its inception, the sorghum-breeding program planned to draw from global sources those species and varieties that could contribute the factors essential for improvement, by breeding, of the productiveness of this plant. War conditions have almost wholly prevented collections of breeding material, forcing the plant breeder to use the limited range of types available in United States. Investigations on improvement in yields by better cultural methods, including use of fertilizers and by disease control, are going forward. However, best progress in the investigations and an ultimate successful outcome depend on utilization of new breeding material. In the interim, and as breeding research continues, sirup types of sugar sorghum are being used in a trial way for manufacture of sugar, in experimental quantities. These trials, however, must be considered as precursors of the final objective; namely, the utilization of high-yielding types whose sugar quality will make them real co-partners of sugarcane or sugar beets as source plants for sugar.

Nature has given us in sugar sorghum a plant unique among the grasses, in that this species, grown from seed, matures stalks extremely rich in sugar in a brief span of months. The varieties now available in United States have stemmed almost exclusively from temperate regions in Africa. Although adequate in sugar quality, their acre-yields of cane, averaging 5 to 10 tons per acre, obviously are not comparable with sugarcane yields, averaging approximately 21 tons. However, there exist, scattered in native gardens of Equatorial Africa, tropical forms of sorghum characterized by sweet juices and large-barrelled stalks. What is needed is an intermediate form adapted to our conditions. It is not beyond reasonable expectation for the plant breeder, given the lush-growing tropical types and our own high-sugar, but low-yielding, types as breeding materials, and with the new techniques, which now make it possible to cross diverse forms, to achieve the combination of yield and sugar quality requisite for an economic sugar-bearing plant suited to our conditions.

(t) Tobacco Investigations

Appropriation Act, 1944	\$120,520
Anticipated deficiency for overtime pay required by the	
War Overtime Pay Act of 1943	+10,500
Total anticipated available, 1944	131,020
Budget estimate, 1945	<u>131,020</u>

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. Tobacco production, breeding, disease, and quality investigations	\$124,580:	\$131,020:	\$131,020:	- -
Covered into Treasury in accordance with Public Law 674	90:	- -	- -	- -
Unobligated balance	2,280:	- -	- -	- -
Total available	126,950:	131,020:	131,020:	- -
Anticipated deficiency for overtime pay	- -	-10,500:	- -	
Total estimate or appropriation	126,950:	120,520:	131,020:	

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$5,593:	\$ 2,093:	\$ 2,136
Additional funds for overtime (appropriated, 1943, estimated supplemental 1944; and included in budget estimate, 1945)	- -	10,500:	10,500
Total cost of overtime (7 months in 1943) .	5,593:	12,593:	12,636

WORK UNDER THIS APPROPRIATION

Objective: Under wartime shortages of farm labor, materials, and equipment, the principal objective is to aid growers in maintaining production from the limited acreage they will be able to grow under these conditions, by reducing losses from disease and other hazards, improving the yield of desirable grades of leaf, and reducing costs of production.

The Problem and its Significance: The annual tobacco crop of about 1,400,000,000 pounds, with a farm value of more than \$400,000,000, is grown on 1,500,000 acres distributed mainly through 15 States. In the principal producing areas tobacco is the chief cash crop of the growers. Taxes on manufactured tobacco yield an annual Federal revenue of about \$800,000,000.

In order that growers may realize fair returns from the limited tobacco acreage they will be able to maintain under existing conditions, it is essential that they produce the maximum possible yields of the grades of leaf required for domestic manufacturing purposes. Many of the present

varieties and strains of tobacco are poorly adapted to use of intensive methods of production now urgently needed, particularly when the crop is grown on other than the very best tobacco soils. Problems of weed and disease control, proper soil tilth and reducing heavy losses from unfavorable weather conditions, resulting from more or less general transfer of plant beds from newly reclaimed wood land to old land in the field, are emphasized by a present scarcity of equipment for steaming plant bed soil. In the field, systems of cropping and soil management are needed which will minimize the hazards of unfavorable weather conditions, and at the same time avoid injury to yield and quality of tobacco likely to result from growing leguminous crops such as soybeans and lespedeza, as a result of the accumulation of nitrogen in the soil, a factor that must be watched carefully in connection with tobacco. There is, also, the special problem of growing tobacco as a source of nicotine for insecticidal use so as to increase the present limited supply of nicotine available from tobacco byproducts.

Diseases reduce the value of the crop each year by 10% to 20%. In the South about 500,000 acres of tobacco are grown each year on root-knot infested soil which greatly reduces the yield; in central North Carolina Granville wilt has decreased by one-half the value of the finest tobacco land; blue mold causes severe shortage of plants and costs growers millions of dollars for additional seed beds; wildfire is destructive in Tennessee, Kentucky, and Pennsylvania; black shank, a new and unusually destructive disease, is spreading rapidly in the South; in northern areas black root rot everywhere seriously lowers yields.

General Plan: Each distinctive type of tobacco presents special cultural problems because of varying standards of quality and regional differences in soil, climate, disease distribution, and other factors. Cooperative experiments are carried out with the agricultural experiment stations of the tobacco-growing States of Pennsylvania, Maryland, North Carolina, South Carolina, Georgia, Tennessee, and Wisconsin. No independent field stations are maintained.

Examples of Progress and the Current Program:

Meeting emergency needs: The tobacco supply and demand situation and the shortage in experienced farm labor indicate that a considerable average increase per acre in output of leaf of satisfactory quality is the most important need in meeting crop production goals. Skilled farm labor requirements are unusually high in the case of the tobacco crop (400 man hours per acre) and principal measures in securing most effective utilization of limited manpower in meeting increased production needs include reducing the hazards of disease and weather in the plant bed and in the field, using better yielding varieties and more intensive production methods, and devising labor-saving procedures. Developments of the past year and present trends lend emphasis to this situation. It has been found that increased output through application of intensive methods should be obtained primarily by increasing the weight of the leaves and not the number produced, assuring maximum savings in labor and plantings

required. To this end liberal fertilization of the crop is an essential requirement and chief problems here are use of safe substitutes for standard organic fertilizer materials previously used very generally but not now available, and correct methods and time of application of the modified fertilizer mixtures.

Controlling diseases: Tobacco diseases apparently will reduce the 1943 crop by 15% to 20%, with corresponding losses in manpower and materials. Blue mold investigations have resulted in the development of three methods of control; namely, paradichlorobenzene gas, copper oxide-oil spray, and bismuth salicylate spray. Present treatments are effective, but to meet the need for a method of control that is simpler so as to insure more general use, work is in progress on the development of dust treatments and preliminary results are promising. The ultimate solution of the blue mold problem is development of resistant varieties, and intensive breeding work in this direction is in progress. Black shank and Granville wilt are two extremely destructive diseases that often reduce growers' crops by 25% to 50%. Black shank resistant flue cured varieties were released in 1943, and it is planned to release Granville wilt resistant varieties for limited use in 1944. These releases are to meet emergency needs, and much work remains to be done to improve the present varieties with respect to resistance, yield, and quality. Black shank and wilt have now appeared in the same areas, and work is in progress to combine resistance to both diseases in one variety. Breeding work is also under way to obtain resistance to root knot, mosaic, and wildfire, all of which are important and destructive diseases. Rotation studies have shown that root knot control can be secured by growing tobacco after peanuts, and further studies are being conducted to develop cropping systems that will increase production by disease control.

The plant bed problem: Throughout a large portion of the southern tobacco-growing area farmers during the past season lost 75% to 80% of their seedlings from late freezes followed by blue mold, resulting in very late transplanting, use of inferior plants, and a very irregular, light weight crop. Preliminary experiments showed that by proper choice of location with reference to sunlight and use of windbreaks and suitable temporary plant bed covering these huge losses, which frequently occur in varying degree, could have been largely avoided. It has been demonstrated that treatment of the soil with urea, cyanamid, and other chemicals more effectively controls weeds and soil-borne diseases than the steaming process which, moreover, is available only to a very limited number of farmers under the emergency conditions. Work is in progress in finding simple, safe, and economical procedures for general use of the chemical treatments.

New varieties and more intensive methods: Flue cured varieties 400 and 401, recently released and extensively grown this year for the first time, are especially suitable for present emergency conditions in that, contrary to general experience with the ordinary varieties, they can be grown successfully under intensive conditions, so as to secure maximum yields without serious impairment of quality, thus affording a definite contribution to the manpower problem. Tests now in progress should furnish data of

immediate value in indicating how far the more intensive procedures, including heavy fertilization and culture in rotation with leguminous food and feed crops, can be safely pushed. Other new varieties are now ready for similar tests. In view of the need for liberal fertilization, coupled with the nature of the substitutions in the fertilizer formula now required, wise choice of substitute materials is increasingly important. In this connection recent results with the so-called trace elements, which are commonly present in many fertilizer materials, indicate that the reserves in tobacco soils are adequate for immediate needs while in the case of boron the quantity supplied in the fertilizer must be kept quite low to avoid crop injury. Of immediate interest, it is found that the beneficial effects which have been obtained from high fertilization with German sulphate of potash are not due to trace elements as impurities; domestic sulphate gives equally good results. For the double purpose of partly overcoming the serious hazards of both excess and deficient rainfall and reducing labor requirements in cultivation of the crop, special efforts are being made to devise the most effective procedures for obtaining the full mulching benefits from weed and crop plant residues and from the ridge method of culture, including double-row planting. Tests have indicated that, with the use of a stoker, tobacco can be flue cured more economically with coal than with wood. In these tests fuel costs were about 50% lower, and since the equipment is semi-automatic in operation, an even greater saving is effected in skilled labor required for supervision of curing.

Nicotine for insecticidal use: The problem of an adequate supply of raw material to meet the increased needs for nicotine as an insecticide has become more difficult because of increase in cost of growing tobacco and the temporary sharp rise in price of low grade dark tobacco normally diverted for nicotine extraction purposes. An important step in meeting the problem is development of varieties of rustica capable of yielding larger quantities of nicotine. Work on this problem is being pushed, and three new promising varieties are being tested. It is hoped that a new strain now being developed, which has mammoth or indeterminate growth habits, in contrast with the short life cycle of ordinary rusticas, will pass successfully through limited periods of drought, against which the ordinary rustica varieties are so vulnerable, without undergoing permanent stoppage of growth.

(u) Special Research Fund, Department of Agriculture

(Allotment to Bureau of Plant Industry, Soils, and Agricultural Engineering)

This budget schedule covers obligations under an allotment for work conducted under Special Research Projects and Regional Laboratories.

(v) Conservation and Use of Agricultural Land Resources

(Allotment to Bureau of Plant Industry, Soils, and Agricultural Engineering)

This budget schedule covers past obligations under an allotment for analysis of samples of fertilizer materials used in the agricultural conservation program.

(w) Emergency Fund for the President, National Defense
(Transfer to Bureau of Plant Industry, Soils, and Agricultural Engineering)

This budget schedule covers obligations under a transfer for emergency plant disease prevention.

(x) Rubber Investigations

This budget schedule covers obligations during the fiscal years 1943 and 1944 under the unobligated balance of an appropriation made by the Second Deficiency Appropriation Act, 1940, for surveys and investigations relating to development of rubber production in the Western Hemisphere, as explained in greater detail below.

WORK UNDER THIS ALLOTMENT

Objective: To develop rubber production in quantity in the Western Hemisphere, through breeding disease-resistant, high-yielding strains of the Para rubber tree, Hevea brasiliensis, determining best cultural and harvesting practices, and making available to cooperating countries improved strains and methods, thus providing a source of rubber supply relatively close to the United States and aiding indirectly in the establishment of a more complementary, balanced trade between the United States and Latin America.

The Problem and its Significance: Prior to Pearl Harbor about 97% of the world's rubber production came from Far Eastern plantations of the Para rubber tree, Hevea brasiliensis, native to the Amazon jungles but taken in 1876 to European possessions in the East. The United States used over 50% of the total world supply of rubber, and 97% of our imports of necessity came from these distant producing areas which now, with the exception of Ceylon and India, are entirely in the hands of the enemy.

Tropical areas of the Western Hemisphere suitable for the Para rubber tree extend from southern Mexico to northern Brazil and Bolivia. This region comprises portions of fifteen Latin American republics representing a great variety of soils, climates, and native populations.

In order to effect wide-scale rubber production in these areas, the small-farm or single family type of enterprise is encouraged, because population density and labor costs therewith are not limiting factors. This will enable direct competition with the East, where 50% of prewar production came from small native plantings of unselected seedling trees yielding only 250-400 pounds per acre per year. Such yields may be contrasted with 1,000 pounds per acre expected from the superior strains being planted by natives of the Western Hemisphere. The use of superior strains involves the process of bud-grafting and other complicated operations which require intensive educational work. The highest yielding strains are susceptible to South American leaf blight, and must be crown-budded with resistant material. Continued selection and testing of strains of the latter will be necessary to combine high yield with the resistance before

they can supplant the Eastern importations and simplify commercial planting. Nevertheless, field planting with present material is accelerating by many thousands of acres annually.

General Plan: The Bureau of Plant Industry, Soils, and Agricultural Engineering is primarily responsible for the technical work done, including surveys, disease studies, breeding, testing, selection, and propagation of superior strains, and technical guidance of all practical operations during the initial years. Investigational work is confined largely to three field stations supported mainly by the Bureau and strategically located in Costa Rica, Haiti, and Honduras. Technical assistance is furnished by personnel stationed at cooperators' headquarters in ten of the countries.

Examples of Progress and Current Program: During the past three years cooperative projects have been established with fourteen Latin American Republics. Intergovernmental agreements provide for necessary research, and obligate this Department mainly to supply the initial stocks of superior planting material along with technical assistance essential to the establishment of a sound industry. Taken as a whole, the project now is only emerging from the nursery stage which, naturally, must precede widespread commercial planting.

In the fiscal years 1942 to 1944, the cooperating governments have established experimental stations or national nurseries within their own boundaries at their own expense. Central experiment stations for general research and primary distribution of superior strains of the tree were established in Costa Rica, Haiti, and Honduras, mainly at the expense of this Department. From these stations the Department is carrying out its obligations for supplying plant materials and technical guidance on all phases of rubber production. An important feature is the training of local nationals, who then carry out the details and arrangements with individual growers in each of the countries.

A cooperative breeding program with Brazil and the Ford Company, the work of multiplication and distribution of superior planting stocks by the Department's field stations, and investigational and technical guidance activities in most of the countries are now actively under way to aid in solving the problems and establishing rubber production in the shortest possible time.

More than 100 of the highest yielding strains of the Hevea rubber tree, developed during 30 years of research in the Far East, were imported prior to the outbreak of war, and the best are being utilized in this program. They are protected from leaf blight by crown-budding them with material highly resistant to that disease, and this assures safe and uninterrupted planting until selections combining both the resistance and superior yield have been multiplied for general distribution. More than 70 Ford clones and selections combining resistance with indicated superior yield are being multiplied for distribution to growers in all cooperative countries.

More than twenty-five million rubber seed have been planted in cooperating countries for production of nursery root stocks on which to budgraft superior strains for field plantings. An estimated 18,000 acres of the latter will have been planted by the end of 1944.

(y) Emergency Rubber Project, Department of Agriculture
(Allotment to Bureau of Plant Industry, Soils, and Agricultural Engineering)

This budget schedule covers obligations under an allotment for production, culture, handling, soil requirements, and machinery investigations on guayule and other emergency rubber crops.

(z) Working Funds (Bureau of Plant Industry, Soils, and Agricultural Engineering)

This budget schedule covers obligations under advances, pursuant to Section 601 of the Economy Act of June 30, 1932, for services performed for various agencies as indicated in the following statement of obligations under supplemental funds.

Continuation of the program for development of rubber production in the Western Hemisphere is provided for by transfer from the Department of State appropriation "Cooperation With the American Republics." A transfer of \$275,000 to the Department for this purpose has been made for the fiscal year 1944, and the budget estimates for 1945 contemplate the transfer of \$310,000 for this work in the fiscal year 1945. A schedule of obligations appears in the printed Budget under the State Department, page 625. The item is considered by the Subcommittee on Appropriations for State, Commerce, Justice, and the Judiciary, as an important part of the program for cooperation with the American Republics being conducted under the general supervision of the Secretary of State.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS

Item	Obligations 1943	Estimated obligations 1944	Estimated obligations 1945
<u>Rubber Investigations: Surveys and investigations relating to rubber production in Western Hemisphere.</u>	\$ 54,500	\$ 15,500	- -
<u>Removal and Reestablishment of Arlington Farm, Virginia (Transfer to Agriculture)</u>	300,998	- -	- -
<u>Soil Conservation Service (Allotment to BPIS&AE): Inspection and correlation of surveys</u>	99,000	187,758	\$ 195,568

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS - Continued

Item	Obligations 1943	Estimated obligations, 1944	Estimated obligations, 1945
<u>Special Research Fund, Department of</u>			
<u>Agriculture:</u>			
Special research projects	128,970:	144,325:	137,846.
Special research laboratories in major agricultural regions ...	280,850:	330,091:	330,091
Total, Special Research Fund	409,820:	474,416:	467,937
<u>Conservation and Use of Agricultural</u>			
<u>Land Resources:</u> For analysis of fertilizer materials in agri- cultural conservation program:....	8,325:	-	-
<u>Emergency Fund for the President,</u>			
<u>National Defense:</u> For emergency plant disease prevention	10,900:	206,100:	-
<u>Emergency Rubber Project, Department</u>			
<u>of Agriculture:</u> Investigations directed toward the production of rubber from guayule and other rubber-bearing plants	398,021:	792,785:	324,010
<u>Working Fund Advances from:</u>			
<u>State Department:</u> Cooperation with the Chinese Government in the study of agricultural problems .	4,414:	6,228:	1,281
<u>Foreign Economic Administration:</u>			
Continuance of cinchona bark de- velopment program in Colombia and Peru as a source of quinine	3,615:	2,615:	-
<u>War Production Board:</u>			
Investigations on milkweed as a source of fiber	-	56,000:	-
Investigations in food compres- sion and packaging of dehy- drated compressed food pro- ducts	-	43,200:	-
Total, War Production Board.	-	99,200:	-

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS - Continued

Item	Obligations 1943	Estimated obligations 1944	Estimated obligations 1945
Commodity Credit Corporation: De- velopment of methods of properly caring for grain in storage	17,173:	17,500:	- -
Total Working Funds	25,202:	125,543:	1,281
Cooperation with American Republics (Transfer from State): 1/			
Rubber investigations in Western Hemisphere	148,000:	275,000:	310,000
Intern training for students in engineering and plants	- -	- -	9,400
Total, Cooperation with Amer- ican Republics	148,000:	275,000:	319,400
Total Obligations under Supplemental Funds ...	1,454,766:	2,077,102:	1,308,196

1/ The budget schedule relating to these projects appears in the State Department section of the Budget (see page 625).

PASSENGER-CARRYING VEHICLES

The estimates for the Bureau of Plant Industry, Soils, and Agricultural Engineering contemplate the purchase of 10 passenger-carrying vehicles in the fiscal year 1945, at an estimated cost of \$8,500, based on the availability of cars and the probability that second-hand rather than new cars will have to be purchased. No passenger car purchases are contemplated in the fiscal year 1944, except for 5 second-hand cars for an emergency plant disease prevention project being conducted under a special allotment. The 10 cars estimated for purchase in 1945 are to replace vehicles with mileage in excess of 60,000 that it may not be possible to keep in satisfactory operating condition in the fiscal year 1945.

In accordance with mileage administration and control in effect throughout the Government, the Bureau's cars are being conserved and used only for essential investigations on crop production problems related to the war program in localities where other means of transportation are inadequate or non-existent.

In normal times the most economical procedure is to trade in from 20% to 25% of the cars each year, with an average age of 4 to 5 years and mileage of 40,000 to 50,000 miles. Under present conditions, new cars are practically

unobtainable, and every effort is being made to keep present cars in satisfactory operating condition to perform essential work. The estimate for replacement of 10 vehicles with second-hand cars is intended to provide authority for purchase if replacements are available and if existing cars cannot be continued in operation. If the 10 vehicles estimated for purchase are not obtained, the funds will be required for maintenance and repair of present cars.

AGRICULTURAL RESEARCH ADMINISTRATION

Bureau of Entomology and Plant Quarantine

(a) General Administrative Expenses

Appropriation Act, 1944	\$138,420
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	22,300
Total anticipated available, 1944	160,720
Budget estimate, 1945	160,920
Increase	+200

PROJECT STATEMENT

Project	1943	1944 :(Estimated):	1945 :(Estimated):	Increase or decrease
1. General administration and business service	\$155,098:	\$160,720:	\$160,920:	+\$200
Unobligated balance	402:	- - :	- - :	- -
Total available	155,500:	160,720:	160,920:	+200 (1)
Transferred to:	:	:	:	:
"Salaries and expenses, Office of Information" ..	+1,100:	- - :	- - :	:
"Salaries and expenses, Office of Administrator, Agricultural Research Administration"	+2,000:	- - :	- - :	:
"Salaries and expenses, library"	+12,300:	- - :	- - :	:
Anticipated deficiency for overtime pay	- - :	-22,300:	- - :	:
Total estimate or ap- propriation	170,900:	138,420:	160,920:	:

INCREASE

(1) The increase of \$200 in this item for 1945 is for overtime pay required under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	: *\$655:	- -	- -
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	: 10,900:	22,300:	22,500
Total cost of overtime (7 months in 1943) :	11,555:	22,300:	22,500

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

The funds provided under this appropriation are used for general administrative purposes comprised of the following functions: (a) Determination of policies; (b) general administrative supervision of all departmental and field activities; (c) business operations; (d) the approval and preparation for publication of manuscripts concerned with the scientific, technical and other activities of the Bureau; (e) the preparation and distribution of general information on control of insect pests; and (f) the handling of general information relating to federal quarantines and the preparation of cases on quarantine violations.

(b) Fruit Insects

Appropriation Act, 1944	\$399,130
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+57,500
Total anticipated available, 1944	456,630
Budget estimate, 1945	457,230
Increase	<u>+600</u>

PROJECT STATEMENT

Project	: 1943	: 1944 :(Estimated):	: 1945 :(Estimated):	: Increase or decrease
1. Deciduous fruit insects .	\$187,151:	\$215,886:	\$215,986:	+\$100
2. Subtropical fruit in- sects	44,392:	49,644:	49,644:	- -
3. Investigations on fruit- flies which are potential pests in Continental United States	71,338:	72,016:	72,216:	*200
4. Investigation on Japanese beetles	106,211:	119,084:	119,384:	+300

PROJECT STATEMENT - Continued

Project	1943	1944 (Estimated)	1945 (Estimated)	Increase or decrease
Covered into Treasury in accordance with Public Law 674	500:	- -	- -	- -
Unobligated balance	5,238:	- -	- -	- -
Total available	414,830:	456,630:	457,230:	+600 (1)
Transferred to "Salaries and expenses, Office of Administrator, Agricultural Research Administration" ..	+4,000:	- -	- -	- -
Anticipated deficiency for overtime pay	-	-57,500:	-	-
Total estimate or appropriation	418,830:	399,130:	457,230:	-

INCREASE

(1) The increase of \$600 in this item for 1945 is for overtime pay required under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	*\$19,236:	- -	- -
Additional funds for overtime, (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	10,200:	\$57,500:	\$58,100
Total cost of overtime (7 months in 1943):	29,436:	57,500:	58,100

*Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To develop means whereby the growers of fruits and nuts can control insect pests more effectively or more economically, thus increasing the net returns from their operations and insuring the armed forces and the consuming public an ample supply of fresh and dried fruit of high quality. In addition, to develop methods whereby home owners may protect their plantings from attack by Japanese beetle; to develop methods whereby the movement of various agricultural products from areas infested by the Japanese beetle to uninfested territory may be made without danger of

spreading the insect; to stimulate to the fullest possible extent use of the parasites and diseases which tend to control the Japanese beetle. In the case of the Parlatoria scale, to obtain a thorough understanding of the biology and host plant relations of this pest and to develop adequate methods for controlling it.

The Problem and its Significance: Fruits and nuts are crops of major importance in the United States, the farm value of some of the more important of which were reported in 1940 as follows: Citrus fruits, \$120,000,000; apples, \$94,000,000; peaches, \$43,000,000; grapes, \$45,000,000; and pears, \$21,000,000. The value of fruits in a well-balanced national diet is recognized, and it is essential that an adequate supply of fruit be available to the armed forces and the consuming public.

All of the fruit crops are subject to serious attack by insect pests. Some of the major annual losses, including the cost of control measures, have been estimated as follows: Codling moth, \$31,000,000; plum curculio, \$10,000,000; and San Jose scale, \$7,380,000. Many growers of apples spend \$50 to \$60 per acre for codling moth control, and some citrus growers spend even more for fumigation and other measures for the control of scale and other pests. Next to freezes and other unfavorable weather conditions, destruction of crops by insect pests is the most likely to prevent the attainment of production goals, which for 1943 were 97 percent of normal for fresh fruits, while for dried fruits maximum production was essential due to increased military and lend-lease requirements and greater civilian demand because of the considerable reduction in supplies of canned fruits and juices. Insecticide shortages, threatened and actual, make necessary the modification of standard control recommendations and the development of information on substitute materials for war limited insecticides and on the possible value of new insecticide materials as such become available.

Losses by the Japanese beetle are difficult to estimate on a financial basis, since a great deal of damage occurs to shade trees, ornamental shrubbery, and in flower gardens, where the injury does not represent a reduction in the owner's income. However, a WPA survey made in 1934 indicated a loss of nearly a million dollars to growers of farm crops in one New Jersey county alone. This means that this one insect must cause a total damage to crops over the entire infested area of many millions of dollars with consequent reduction in food production.

General Plan: The research work on fruit insects is carried on at 23 field laboratories, which are maintained at suitable locations, mostly in the producing areas where the particular insect problems to be investigated are especially serious. Much of the work is cooperative with State agricultural experiment stations or other State agencies, and in several cases is carried on cooperatively by two or more divisions of this bureau.

Examples of Progress and Current Program: The discussions which follow indicate the present trend of the work under the respective projects and outline briefly some of the recent accomplishments.

Investigations of insects affecting deciduous fruits: At field laboratories in the Pacific Northwest, the Ohio River Valley, and the East efforts continue to be directed towards the development of insecticide or other means of controlling the codling moth that would be more effective and less objectionable than lead arsenate from the standpoint of poisonous residue left on the fruit and its effect on trees and orchard soils. Among the large number of chemicals tested, the greatest promise has been shown by a complex organic compound first developed in Switzerland, and for convenience referred to as "DDT". This material has been found to be very poisonous to the codling moth, both in laboratory tests at Beltsville, Maryland and in laboratory and field tests at Vincennes, Indiana.

The Vincennes, Indiana laboratory has continued to obtain very favorable results with the newly-developed nicotine bentonite formula for codling moth control, which employs a cheap Mississippi bentonite instead of Wyoming bentonite, eliminates the use of soybean oil, at present a scarce material, and furthermore results in very little visible residue on the fruit. This treatment has already been adapted for commercial use by a limited number of mid-western growers who most seriously need a more effective material than lead arsenate.

In the Pacific Northwest the development of improved stickers resulted in control of the codling moth with one pound of micronized phenothiazine equal to that previously obtained with two pounds. Combination sprays of phenothiazine with lead arsenate, and mixed spray schedules with lead arsenate in early applications and phenothiazine later, gave good results, but the unsatisfactory effect on size and color of fruit continued. Until this difficulty can be overcome, the material can hardly be recommended for use by practical growers.

A study of codling moth larvae from 7 different middle western orchards, carried on by the Vincennes, Indiana laboratory, showed wide differences in the effect of lead arsenate on strains of codling moth worms from different orchards, which offers at least a partial explanation of the differences in control obtained by commercial growers. Nicotine bentonite has been found very effective in cleaning up infestations in orchards in which lead arsenate appears to have become ineffective.

At Yakima, Washington a large-scale orchard test of sprays containing a "dinitro" compound, applied during the dormant season to the trunks and scaffold limbs of apple trees to destroy overwintering codling moth worms in cocoons, resulted in a cleaner crop than where no such treatment was made, or even where the trees were merely scraped and banded.

Although several serious new apple orchard infestations of the Comstock mealybug were reported from Virginia, Delaware, New Jersey, and Connecticut, this insect was very scarce in 1943 in certain orchards of central and southern Virginia, West Virginia, and southern Ohio, while infestations were relatively light in northern New Jersey and Connecticut. The very considerable reduction in populations in certain of the older infested orchards resulted from the activities of the

introduced Japanese parasites and, in Virginia and Ohio at least, also to the work of a native fungus disease. Colonization of the Japanese parasites Allotropa burrelli and Pseudaphycus sp., and also of A. convexifrons, a species which occurs naturally in New Jersey and Connecticut, is being continued in cooperation with State agencies in an attempt to establish these promising parasites as rapidly as conditions permit in all orchards known to be infested with this mealybug. Several species of parasites of other mealybugs from California, Canada, and Hawaii have been tested under laboratory conditions to determine their possible usefulness against the Comstock mealybug.

Continued studies of the new scale insect Parlatoria chinensis at St. Louis, Missouri have shown that this insect survives the winter only in the adult female stage. An infestation of only a few individuals was found to cause perceptible localized injury to fruit trees such as apple. Commercial control of this scale insect was obtained with 3 or 4 percent lubricating oil emulsions applied during the dormant or delayed-dormant season. Paraffin base oils were superior to naphthene base oils, and quick-breaking types of oil emulsions were more effective than more stable types.

Further investigations at Fort Valley, Georgia to develop a satisfactory substitute for lead arsenate in control of the plum curculio on peach, have shown two applications of dichloroethyl ether emulsion to the soil beneath the spread of peach trees in a commercial peach orchard against larvae and pupae to be as effective in controlling that insect as the regular schedule of lead arsenate sprays on the fruit. Laboratory and caged-tree experiments also confirmed previous indications that di(2-chloroethyl) formal, used in the same manner, has considerable promise.

Further experiments with propylene dichloride by the Fort Valley, Georgia laboratory have shown that material to be more effective than ethylene dichloride for peachtree borer control, but somewhat more likely to cause injury when used at the same concentration.

The work on parasites of the oriental fruit moth, carried on at the Moorestown, New Jersey laboratory, was somewhat modified in the spring of 1943 to include the distribution of the parasite Macrocentrus ancylovorus Roh. to a number of peach-producing localities where the fruit moth is causing injury and from which the parasite appears to be absent. Included were shipments of that and other parasites to southern California, where the oriental fruit moth was found for the first time in the fall of 1942. Methods of breeding M. ancylovorus from the strawberry leaf roller were still further improved and preparations were made in the fall of 1943 to undertake breeding of that and other species of oriental fruit moth parasites on the potato tuber worm.

Due to unusual weather conditions in the vicinity of Moorestown, New Jersey in 1943, a very heavy population of first generation oriental fruit moth larvae in the twigs was followed by an abundance of second generation larvae, an unusually large portion of which infested the fruit

and thus largely escaped parasitization, followed by severe injury to ripening fruit by third generation larvae. As a result, for the first time in a series of experiments conducted over a period of 6 years, mass liberation of parasites did not effect a measurable reduction of oriental fruit moth injury to peach fruit. However, in experimental orchards in which mass liberations of parasites were supplemented by the use of bait traps to reduce the adult moth population, substantial reduction in injury to the fruit resulted despite the unusual season.

At East Chattanooga, Tennessee final readings of transmission tests initiated in 1939 and 1940, and first reading of tests started in 1941 with insects that may transmit the phony peach disease have given entirely negative results. During the first 3 quarters of the calendar year 1943 approximately 150 new transmission tests were started with insects suspected of transmitting phony peach disease. Final readings taken on tests started in 1939-41 with 12 species of insects suspected of transmitting peach yellows also gave negative results.

The San Bernardino, California laboratory initiated 430 transmission tests during the first 3 quarters of 1943 with insects suspected of transmitting peach mosaic, and took readings of previous tests in Texas and California, all of which gave negative results. In addition, 221 transmission tests with insects suspected as vectors of Western "X" disease were undertaken in Utah and Washington.

At Albany, Georgia further experiments in cultural control of the hickory shuckworm in pecan orchards, by destruction of worms in infested drop nuts through the use of a disk tiller, substantiated the very favorable results obtained during the two previous seasons. The use of this implement reduced the infestation by more than two-thirds and more than doubled the yield of nuts. At Brownwood, Texas experiments in the control of the pecan nut casebearer have shown that a single application of lead arsenate with nicotine sulfate and mineral oil emulsion is more effective and less expensive than the treatment heretofore recommended, which consisted of two applications of lead arsenate.

Continued investigations of the filbert worm in Oregon have given information on the biology and habits of the insect that will be helpful in developing control measures. Preliminary results indicate the possibility of reducing insect damage to filbert nuts by removing and destroying all nuts that drop prior to harvest.

Special attention is being given by the Dried Fruit Insect Laboratory at Fresno, California to the problems involved in the control of insects that attack dried fruits in stores intended for army or other military use. As a basis for work with the insect-proof qualities of dried fruit packages, studies have been made to determine the size opening that will permit the entrance of various insects. Tests have been made of the insect-proofness of several types of containers, and arrangements are being made for more extensive tests. Dipping for six seconds in boiling water has been found effective for killing insects in certain dried fruits.

Progress towards control of the saw-toothed grain beetle, the most serious pest of stored raisins, has been made by use of oil-filled trough barriers about the stacked boxes. Although these beetles do not fly, some of them crawl to the roof of the storage structure and drop to the stacks. Efforts are therefore being made to develop measures to prevent beetles from reaching the overhead timbers.

Ammonium sulfamate proved to be the safest, most effective, and most easily applied of any material tried by the Yakima, Washington laboratory to kill pear stumps, sprouts, or regrowth in connection with the pear psylla control program. It is very effective as a spray on the foliage of suckers and does not have the sterilizing effect on the soil of other materials such as salt or borax. The killing of pear regrowth eliminates it as breeding grounds for the pear psylla.

Experiments carried on in vineyards near Sandusky, Ohio in 1942 indicate that it is possible to reduce grape berry moth infestation by approximately 50 percent in a single season with cultural control methods. However, in 1943 abnormal rainfall during the spring months made it almost impossible to practice cultural control methods, except in vineyards located on very sandy types of soils. In combination spray tests for control of grape leafhoppers and the grape berry moth, the addition of 1 pint of nicotine sulfate in the second spray of a 2-arsenical spray schedule gave good control of leafhoppers.

Investigations of citrus and other subtropical fruit insects: It has been determined by the Whittier, California laboratory that the resistance of California red scale populations to hydrocyanic acid varies from grove to grove. Repeated fumigations of resistant stocks of scales from several sources through as many as 14 generations continued to increase the average resistance of the scale population to HCN.

Additional improvements have been made in the blower type cyanide applicator for use in fumigation of citrus trees for red scale control. Further studies of tent fabrics have shown gas concentrations and scale mortality to be as high under tents treated with a plastic as under a gastight box. Poorest results were obtained under tents of duck, while latex-treated sheeting gave intermediate results.

Spray tests with derris resins added to extra light oil showed further promising results in control of California red scale. Toxicity tests with a number of other materials added to oil sprays disclosed nothing approaching the effectiveness of derris or cube extracts, which unfortunately are not now available for the spraying of citrus.

Additional experiments on a larger scale than formerly, conducted by the St. Lucie, Florida Laboratory to determine the influence of cover crops on abundance of the citrus rust mite in orange groves, have indicated both in 1942 and 1943, that rust mite populations are not materially affected by either clean-cultivation or cover-cropping. In

1943, however, significantly greater populations of Florida red scale occurred on trees in the cultivated areas than on those in the cover-cropped areas.

Field tests in 1942 with oil emulsions against Florida red scale on grapefruit and orange trees in Florida indicated that, in general, a cheaper red oil is as effective at a lower concentration as the commercial white oils, and that the addition of derris resins do not materially improve control of this particular scale.

Experiments in Florida during 1943 against the little fire ant failed to substantiate previous preliminary indications that this pest might be controlled in citrus groves with sweet poisoned baits.

Investigations on fruitflies which are potential pests in the continental United States: As was stated in the progress report for the previous year, work in Hawaii has been concentrated on efforts to protect the production of, and to conserve local food supplies, in an endeavor to meet the demands of war conditions. Under the present program work is being continued along these lines, although on a curtailed basis, due to a reduction in the 1944 appropriation. The program is along lines which the local authorities in charge of strategic effort consider desirable. One important line of investigation deals with prevention of infestation of food crops by the melon fly. Some success was attained through the growth of natural barriers to prevent fly dispersal and subsequent infestation.

Investigational work in Mexico consists of research on various species of fruitflies in Mexico that are moving north and entering the United States. In this work the development of both poisons and lures is important. New information on Mexican poison plants as possible sources of insecticides is being developed. It has been found that extracts of jicama seeds are highly toxic to fruitflies. This is a vegetable that is abundantly grown in the tropics. Further progress has been made in the development of selective lures that can be used to determine the presence of fruitfly populations. A satisfactory vapor sterilizing method for mangoes has been worked out with a view to developing a control under which commercial movement of mangoes can be built up. Further activities have been conducted along the line of determining fruitfly mortality values from quick and flash freezing of fruits. Biological studies have been completed in two species of fruitflies and are nearing completion on a third.

Certain facilities of the Mexico City laboratory have been made available to the Office of Economic Warfare and the Rubber Development Corporation along the line of emergency problems arising from the war.

The laboratory in the Canal Zone is a small outpost to build up knowledge on the species occurring in the area and to differentiate characteristics of those that are local from those that range north to the United States, or south into South America. By reasons of location and experience this small outpost serves many purposes. The entomologist in charge cooperates with the Division of Forest Insects on termite resistant studies, and with the Panama Canal Zone authorities on the studies of marine borers, termites, and other insects which create a

local problem. This laboratory also assists the military authorities with shipworm and other problems, and cooperates as occasion may arise with the Inter-American Highway Project.

Investigations of the Japanese beetle: There was rather consistent and noticeable dispersion of the beetle in 1943 throughout the generally infested areas, following favorable conditions in 1942. The most severe infestation in the generally infested area is probably still in and around Hartford, Connecticut, and in a large district in southeastern Pennsylvania, northeastern Maryland, northern Delaware, and southwestern New Jersey. Severe infestations were also present on west-central Long Island, at points in southeastern New York, and in northern New Jersey.

The Moorestown, New Jersey laboratory has continued its work with the milky disease of Japanese beetle grubs, which is the most effective natural control agency found thus far, and wherever it has become well established the Japanese beetle has been very much reduced in numbers. The field distribution work has been continued, and the Bureau has continued to cooperate with various State agencies interested in speeding up the distribution of this disease within their borders. By August 31, 1943, the cooperative program had resulted in the treatment of more than 54,000 sites in 267 counties in 12 States. In addition, the Bureau had treated 6,426 acres of turf on 93 Government-owned reservations in 7 States and the District of Columbia. Additional disease distribution was accomplished in October and November, 1943, but final figures are not available.

Preliminary tests in 1943 with DDT, in both the laboratory and field, showed this new material to be outstanding for use in controlling Japanese beetle adults. A single spray application of 1/4 pound of DDT per 100 gallons of water applied to a peach orchard heavily infested with adult Japanese beetles gave the same protection as a single application of the recommended repellent spray containing 3 pounds of ground derris root. A single application of 1 pound of DDT per 100 gallons afforded satisfactory protection to the fruit and foliage of peach during the entire period when beetles were attacking the trees and also gave excellent control on plums and early ripening varieties of grapes. The DDT remains effective for a longer period than derris and avoids a conspicuous residue on the fruit and foliage such as occurs from the usually recommended lime and lead arsenate repellent sprays. Sprays containing only 3 pounds of lead arsenate to 100 gallons of water were found, on the average, to be 90 per cent as effective as the standard spray containing 6 pounds of the poison, indicating that the lead arsenate content of the standard spray might be reduced to one-half during the present emergency without serious loss in efficiency.

Further studies of substitutes for the scarce materials, geraniol and eugenol, used as attractants in Japanese beetle traps, have substantiated previous findings that anethole, derived from pine oil and satisfying the requirements of the National Formulary, can be substituted for geraniol,

that pimenta leaf oil can be substituted for eugenol, or both geraniol and eugenol can be replaced by the substitute materials without modifying significantly the value of the bait.

A method has been developed and authorized for the nursery treatment of plant balls and potted plants up to 10 inches in diameter, to free them of Japanese beetle grubs and permit their movement outside the infested area. It consists in dipping for 10 seconds in a one percent dilution of an emulsible mixture of ethylene dichloride, and holding the treated plants for 48 hours, within temperature ranges from 45° F. to 75° F.

Preliminary tests in 1943 have shown DDT to have very considerable promise for the treatment of turf to kill Japanese beetle grubs. It is highly toxic to the grubs, 14 pounds of the material applied per acre being approximately equal in effectiveness to 700 pounds of lead arsenate. No injury to the grass resulted when DDT was used at the rate of 50 pounds per acre.

Experiments have shown mixtures of ethylene dichloride and dichloroethyl ether to be highly effective against pupae and eggs of the Japanese beetle in the soil. Dilutions of 1 per cent, when used in sufficient quantities to wet the soil, killed all of the eggs in pots up to 6" in size.

The completion of biological studies carried on in rearing cages in the greenhouse at Moorestown, New Jersey has shown that the Japanese beetle can develop successfully from egg to adult stages in at least 11 soil types common to the Miami, Florida area, and that two generations a year might occur under Florida climatic conditions.

Ten varieties of soybeans, four of which had been included in 1941 studies, were included in further tests in 1942, and 11 varieties in 1943, to determine the resistance of soybean varieties to feeding by the Japanese beetle in an area of heavy infestation. None of the varieties tested were immune to attack, and feeding in general was noticeably heavier than in the 1941 tests. Growing conditions immediately following the period of beetle flight in 1942, however, were so favorable that the plants put on new leaves and the feeding injury did not cause an appreciable reduction in yield. The feeding injury was greatest on the varieties Richland, Lincoln, and Patoka; the varieties most resistant to feeding both years were Chief, Gibson, and Illini.

During 1943, 16,270 females of the parasite Tiphia vernalis Roh. were collected from strong field colonies during May and June and released in Japanese beetle infested areas in 7 states from Rhode Island to Virginia and west to Ohio. Work has also been continued with the parasites T. popilliavora and Centeter cinerea.

(c) Japanese Beetle Control

Appropriation Act, 1944	\$360,120
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 57,000
Total anticipated available, 1944	417,120
Budget estimate, 1945	400,000
Decrease	- 17,120

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. Japanese beetle control operations:				
(a) Supervision of nurseries and greenhouses for Japanese beetle control	\$199,880	\$216,290	\$210,170	-6,120 (1)
(b) Scouting adjacent to nurseries and greenhouses for Japanese beetle control	32,900	35,900	35,900	- -
(c) Trapping to determine distribution of Japanese beetle	63,670	51,200	45,700	-5,500 (2)
(d) Soil treatment and trapping in isolated areas to aid in preventing spread of Japanese beetle	31,100	43,630	43,630	- -
(e) Farm products inspection for Japanese beetle control	23,570	25,500	25,500	- -
(f) Vehicular inspection for Japanese beetle control	31,700	23,200	17,700	-5,500 (3)
(g) Transit inspection for Japanese beetle control	7,400	8,100	8,100	- -
(h) Tests of treatment required for Japanese beetle control	12,029	13,300	13,300	- -
Covered into Treasury in accordance with Public Law 674	3,200	- -	- -	- -
Unobligated balance	3,026	- -	- -	- -
Total available	408,475	417,120	400,000	-17,120
Anticipated deficiency for overtime pay	- -	-57,000	- -	
Total estimate or appropriation	408,475	360,120	400,000	

DECREASES

The decrease of \$17,120 in this item for 1945 consists of:

- (1) A decrease of \$6,120 in the supply item under the project "Supervision of nurseries and greenhouses for Japanese beetle control" due to curtailment of the control program.
- (2) A total decrease of \$5,500 under the project "Trapping to determine distribution of Japanese beetle," consisting of:
 - (a) A decrease of \$5,000 which contemplates a reduction in the number of casual employees assigned to trapping operations in areas throughout the country where efforts are being made to determine the distribution of the Japanese beetle.
 - (b) A decrease of \$500 for overtime pay under the War Overtime Pay Act of 1943.
- (3) A total decrease of \$5,500 under the project "Vehicular Inspection for Japanese beetle control," consisting of:
 - (a) A decrease of \$5,000 which contemplates a reduction in the number of casual employees at inspection points, due to the decrease in motor vehicle travel.
 - (b) A decrease of \$500 for overtime pay required under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	: 1943	: Est. 1944:	Est. 1945
Overtime absorbed	: - -	: - -	: - -
Additional funds for overtime (appropri-	: :	: :	: :
ated, 1943, estimated supplemental,	: :	: :	: :
1944; and included in budget estimate,	: :	: :	: :
1945)	: *\$24,687:	\$57,000	: \$56,000
	: :	: :	: :
Total cost of overtime (7 months in	: :	: :	: :
1943)	: 24,687:	57,000	: 56,000

* Actual appropriation was \$26,200

WORK UNDER THIS APPROPRIATION

Objective: To prevent the spread of the Japanese beetle to sections of the United States as yet uninfested and to facilitate under proper safeguards the movement from infested to uninfested areas of farm products and other plant material and articles which may carry infestation.

The Problem and its Significance: The Japanese beetle is highly destructive to a wide variety of plants used for food, forage and ornamental purposes. The beetle is now well established in certain areas where there is large scale growing of important food crops and other plants, but the insect is not yet known to occur in most of the large food-producing areas of this country. The problem is to protect the latter from infestation by the beetle, and at the same time avoid serious disruption of the shipment of farm products and other plant material from the areas already infested. It is important that the work be so conducted as to maintain public confidence in Federal certification as otherwise non-infested States might enforce local requirements which could interfere seriously with the prompt delivery of perishable farm products.

General Plan: The area regulated by the Japanese beetle quarantine includes parts of Maine, New Hampshire, Vermont, New York, Pennsylvania, Ohio, Maryland, West Virginia, and Virginia, and all of Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, and the District of Columbia. There must be supervision and inspection to insure the proper treatment and handling of the products restricted by the quarantine with a minimum of inconvenience to the public. There must also be a regular survey of premises to determine the status of infestation so that adequate measures, either piece-by-piece inspection, fumigation, or general permit certification, may be adopted in each case. In addition, points in non-regulated territory considered as likely to be infested by the insect are surveyed through the use of traps, and isolated infestations discovered are dealt with either through quarantine or through arrangements with those interested for cooperative control. Arrangements are made for airplane, truck, railroad and mail inspection or treatment of materials as required. Efforts also are made in cooperation with research units of the Bureau to develop new, safe, and inexpensive treatments of plants and plant products to permit them to meet the requirements of inspection and certification.

State cooperation: There are assigned to this project 117 regular employees and the States' complement is 23. This force is supplemented by seasonal employees as required. Practically every State in the regulated area furnishes active cooperation, and the indicated contributions from all States during the fiscal year 1944 total approximately \$310,000.

Examples of Progress and Current Program: A brief description of the work involved in each of the subprojects follows:

Inspection of fruits and vegetables: This involves inspection, treatment and certification necessary to meet quarantine requirements during the flight season of the Japanese beetle. Operations are carried on in Delaware, District of Columbia and in parts of Maryland, New Jersey, Pennsylvania and Virginia at points from which quantities of perishable farm products are shipped throughout

the eastern third of the United States and to Canada. In 1943 considerable quantities were shipped under certification to Army and Navy bases and to war production areas. These products must be moved promptly and with a minimum of handling. Fumigation furnishes a means of providing the necessary certification within the limits of time and safety, and during the 1943 season a total of 5,592 refrigerator cars loaded with fruits and vegetables was fumigated with methyl bromide. During the calendar year 1943 more than 1,900,000 packages of fruits and vegetables were certified for transportation to non-infested sections of the United States and Canada.

Supervision of nurseries and greenhouses: This work includes the certification of plant material from nurseries and greenhouses, involving fumigation and inspection when necessary, for shipment to non-infested sections of this country. With the addition of 4,500 square miles during the fiscal year of 1943 the regulated area now comprises approximately 127,000 square miles, as compared with 98,000 square miles in 1933. It is estimated that the value of this material certified for shipment annually is in excess of \$10,000,000. Inspectors working from central locations certified 87,000,000 units of plant material for shipment from commercial and noncommercial sources during the fiscal year of 1943, as compared with 83,000,000 units in 1942.

Scouting adjacent to nurseries and greenhouses: Regulations of the Japanese beetle quarantine provide for the certification of restricted articles without actual inspection and on an annual basis from uninfested premises within the regulated area. To determine whether these establishments are infested or free, the premises and the environs of each must be surveyed several times during the flight period of the insect for its presence. There are about 1,000 establishments at this time requiring this service.

Trapping to determine the distribution of the Japanese beetle and for control at isolated areas: This work consists of reconditioning, distributing and tending traps which capture Japanese beetles. During the summer of 1943, 42,000 traps were placed and operated outside the regulated area in the following 16 States: Florida, Georgia, Illinois, Indiana, Michigan, Missouri, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin.

Trapping for control was carried on in conjunction with treatment of soil with lead arsenate at isolated infestations in Georgia, Illinois, Indiana, Michigan, Missouri, New York, North Carolina, Ohio, South Carolina, and Virginia. This was done in cooperation with the State or other local governmental agencies.

Soil treatment at isolated areas: When an infestation of the Japanese beetle is found in a new locality at some distance from the region under regulation, the new area represents another source for spread as well as another place for population increase and damage. In these circumstances, an opportunity is offered the State or other interested agency to control the insect in cooperation with the federal government and without necessarily having federal quarantine restrictions invoked.

The value of control work in isolated areas is indicated by the fact that the infestations in areas treated in Georgia, Illinois, Indiana, Kentucky, Michigan, Missouri, North Carolina, Ohio, South Carolina, and Virginia have been reduced or have not developed to a significant degree although some have been known to exist for ten years. During the fiscal year 1943 approximately 1,060 acres were treated at isolated infestations in the following States: Illinois, Indiana, Michigan, Missouri, New York, North Carolina, Ohio, South Carolina, and Virginia.

Vehicular inspection for Japanese beetle control: This work involves the establishment of highway and airport inspection points where vehicles and products moving out of the regulated area may be examined and freed from infestation. Because of the decline in road travel highway inspection was limited to trucks and the period of operation was reduced during the calendar year of 1943. The operation was concentrated on the main highways over which are trucked during the summer large quantities of fruits and vegetables from the sections of heavy beetle population.

During the 1943 season cooperative arrangements to prevent the spread of the beetle via airplanes were made with the War and Navy Departments; also with commercial airlines and plane manufacturers.

Tests of treatments: This work is designed to develop, test and improve treatments to provide efficient and practicable methods of granting certification under the quarantine regulations with a minimum of expense to the federal government and the shipper. As a result of further tests with the ethylene dichloride plant treatment, first approved for use last year, its scope has been widened, and the treatment made more practicable. During 1943 the scope of methyl bromide fumigation of farm products and plant material was expanded to permit its use under practically all of the usual commercial conditions.

(d) Sweetpotato Weevil Control

Appropriation Act, 1944	\$67,770
Anticipated deficiency for overtime pay required by the War	
Overtime Pay Act of 1943	+ 10,700
Total anticipated available, 1944	78,470
Budget estimate, 1945	78,670
Increase	+ 200

PROJECT STATEMENT

Project	1943	1944	1945	Increase or decrease
		(estimated)	(estimated)	
1. Sweetpotato weevil control	\$68,937	\$78,470	\$78,670	+ \$200
Covered into Treasury in accordance with Public Law 674	250	- -	- -	- -
Unobligated balance	2,398			
Total available	71,585	78,470	78,670	+ 200 (1)
Anticipated deficiency for overtime pay	- -	- 10,700	- -	
Total estimate or appropriation	71,585	67,770	78,670	

INCREASE

- (1) The increase of \$200 in this item for 1945 is for overtime pay required under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed.....	\$5,909	- -	- -
Additional funds for overtime (appropriated: 1943, estimated supplemental, 1944; and included in budget estimate, 1945)....	- -	10,700	10,900
Total cost of overtime (7 months in 1943)	5,909	10,700	10,900

WORK UNDER THIS APPROPRIATION

Objective: To cooperate with State agencies in the eradication of the sweetpotato weevil in the sweetpotato-producing areas of the southern States and to assist in the enforcement of regulatory measures promulgated by the States to prevent the spread of the pest.

The Problem and its Significance: In 1941 sweetpotatoes produced in the United States had a farm value of \$58,587,000 and the five States of Alabama, Georgia, Louisiana, Mississippi and Texas grew over 50 percent of the sweetpotatoes produced in the United States. In these States the sweetpotato weevil is a serious economic pest wherever it occurs and, where numerous, it renders sweetpotatoes unfit for any use. The control and eradication of the pest is,

therefore, of major importance to the profitable production of sweetpotatoes. Increased production of this food is particularly essential at this time as it provides an important food for the armed services at home and abroad and for civilian populations. Starch manufactured from sweetpotatoes is now being used in many industries formerly using quantities of imported tropical starches.

General Plan: Activities are designed to accomplish eradication of the weevil in commercial producing areas and to effect its drastic suppression in noncommercial areas to prevent build-up and possible spread to other areas. The work program includes (a) inspections to locate infestations and determine their intensity and possibility of eradication; (b) operations to eradicate the pest from or to control it in infested plantings by means of the destruction of infested seed beds and storage banks, the clean-up of fields after harvest and the eradication of wild host plants; (c) cooperation with States in the enforcement of regulatory measures. Cooperating States are contributing approximately \$86,000 to this program during the fiscal year 1944.

Example of Progress and Current Program: From the beginning of Federal-State control work in July 1937 repeated inspections have been made in 258 counties or parishes in the southeastern and south central States. Infestations were found in 34 counties in the commercial sweetpotato-producing areas and eradication measures were applied. Eradication has apparently been accomplished in 20 of these counties and in the remaining 14 counties eradication measures have apparently been successful on more than 80 percent of all infested properties. Very satisfactory progress is being made in the complete eradication of this pest from these remaining commercial producing counties.

Because of the excellent progress made in the areas where eradication measures have been applied, drastic suppressive measures are now being practiced in 13 additional counties, most of which are in commercial producing areas, to prevent spread of the weevil and to reduce the number of infested properties as rapidly as possible. When it becomes apparent through the reduction of infested properties that complete eradication of the weevil in such counties may be attained they are added to the eradication area.

It is planned to continue intensive reinspections to locate undiscovered incipient infestations and to continue eradication efforts in those commercial producing counties in which the insect has not yet been completely eradicated. Drastic suppressive practices will continue to be applied and enforced in additional counties bordering on the eradication area to prevent the build-up and possible dissemination of the weevil therefrom until such time as the further development of pest control methods makes possible the eradication of the weevil in noncommercial areas which are now considered generally infested and in which the presence of wild host plants makes complete eradication of this pest impracticable through present known methods.

Cooperation with the States is being continued in the enforcement of regulatory measures to prevent the movement of material which might carry the insect to noninfested areas.

(e) Mexican Fruitfly Control

Appropriation Act, 1944	\$155,320
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 13,600
Total anticipated available, 1944	168,920
Budget estimate, 1945	169,820
Increase	+ 900

PROJECT STATEMENT

Project	1943	1944	1945	Increase or decrease
		(estimated)	(estimated)	
1. Mexican fruitfly control:				
(a) Grove and packing house inspection and certification for Mexican fruitfly control	\$128,580	\$154,240	\$155,060	+ \$820
(b) Spraying and control of Mexican fruitfly in Mexico	4,274	5,430	5,460	+ 30
(c) Vehicular inspection for Mexican fruitfly control	7,288	9,250	9,300	+ 50
Covered into Treasury in accordance with Public Law 674	250	- -	- -	- -
Unobligated balance	23,348	- -	- -	- -
Total available	163,740	168,920	169,820	+ 900 (1)
Anticipated deficiency for overtime pay		- 13,600	- -	
Total estimate or appropriation	163,740	155,320	169,820	

INCREASE

(1) The increase of \$900 in this item for 1945 is for overtime pay required under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	: 1943	: Est. 1944:	Est. 1945
Overtime absorbed	:\$12,988	: \$10,000	: \$10,000
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)...	: - -	: 13,600	: 14,500
Total cost of overtime (7 months in 1943)	: 12,988	: 23,600	: 24,500

WORK UNDER THIS APPROPRIATION

Objective: To prevent the spread of Mexican fruitfly from those parts of Texas along the Mexican border where it occurs and co-operate with appropriate official agencies to control existing infestations, thus protecting uninfested fruit-producing regions from this pest which is injurious to many kinds of fruits.

The Problem and its Significance: The Mexican fruitfly is an insect that seriously damages citrus, deciduous and certain tropical fruits in Mexico, where it probably originated. This pest was discovered in Texas in 1927, and infestations of varying degrees of intensity have been found almost every year since that date. During some seasons it has caused important loss to citrus fruit in the Lower Rio Grande Valley of Texas. Within the past few years citrus production within this area has reached a total of between forty-five and fifty-five thousand carloads annually. The presence of this pest is therefore an important economic factor. The problem is to protect as far as possible the quality and marketability of this crop, and through the enforcement of Federal Quarantine No. 64, to prevent the spread of this serious fruit pest from the regulated area in Texas to other fruit-growing regions of the United States.

General Plan: The general work plan is (a) by periodic grove and field inspections through examination of fruit and operation of traps, to determine the presence or absence of the Mexican fruitfly; (b) by inspection of citrus packing and processing plants to insure that fruit being packed, processed, or shipped will be moved in accordance with quarantine regulations; (c) to maintain a complete host-free period, insofar as such susceptible hosts as grapefruit, sour oranges, peaches, etc., are concerned during the period from June 15 to September 1, in order to prevent oviposition and resultant increase in the fly population throughout the summer months; (d) to route fruit from infested groves through sterilization rooms so that any living larvae in the fruit will be destroyed; (e) to inspect markets and groves in Mexico adjacent to the regulated area in Texas with the object of holding down infestations which could easily spread to Texas groves; (f) to control the movement of citrus fruit by motor vehicles through operation of road traffic inspection stations at strategic points.

The work is organized under three projects: (a) Grove and packing house inspection and certification; (b) spraying and control in Mexico; and (c) vehicular inspection.

Examples of Progress and Current Program: A record crop of 54,364 equivalent carlots of fruit was produced during the 1942-43 season. Only 292 citrus plantings, however, were found infested and only 224 flies were trapped. This season's infestation was only slightly above that of the previous year and is much below that of other years when there was an abundance of fruit available for oviposition during the spring months.

Sterilization of fruit from infested properties was started in March and continued throughout the season. Sterilization was required of all the fruit harvested on or about May 6. A total of 1,560 equivalent carlots were sterilized by the vapor-heat method.

Fruit infested with larvae of the Mexican fruitfly was confiscated on the bridge between El Paso, Texas, and Juarez, Mexico. Inspection and trapping operations were carried on during the summers of 1941-42 and 1942-43. Local larval infestations were found both seasons in Juarez and adult Mexican fruitflies were trapped in Texas near El Paso. This new threat to the fruit-growing industry of our Nation is being closely studied.

Traffic passing through the two road stations operated by this Division amounted to only about 60 percent of the volume of the previous seasons. The decrease is due to war conditions and shortage of motor equipment. The facilities of the stations continued to be shared with the Division of the Pink Bollworm Control and the Border Patrol of the Treasury Department.

(f) Citrus Canker Eradication

Appropriation Act, 1944	\$ 9,650
Anticipated deficiency for overtime pay required by the War	
Overtime pay Act of 1943	+ 1,650
Total anticipated available, 1944	\$11,300
Budget estimate, 1945	--
Decrease	<u>- 11,300</u>

PROJECT STATEMENT

Project	: 1943 :	1944 :	1945 :	Increase or decrease
		(estimated):	(estimated):	
1. Citrus canker eradication	: 10,000 :	11,300 :	-- :	- 11,300
Unobligated balance	: 160 :	-- :	-- :	--
Total available	: 10,160 :	11,300 :	-- :	- 11,300 (1)
Anticipated deficiency for overtime pay	: -- :	- 1,650 :	-- :	
Total estimate or appropriation	: 10,160 :	9,650 :	-- :	

DECREASE

(1) The decrease of \$11,300 results from the contemplated elimination of this appropriation: The eradication program has resulted in a gradual decrease in the number of diseased trees or seedlings found, only one having been discovered in the calendar year 1943, and that in January. If no more are found in the remainder of the fiscal year 1944, it is believed the risks might not be too great if the work is discontinued, to await results.

CHANGE IN LANGUAGE

The budget eliminates the appropriation language, inasmuch as it is now expected, as explained above, that no funds will be required in 1945.

Statement of Overtime Costs

	: 1943 :	Est. 1944:	Est. 1945
Overtime absorbed	: 835 :	-- :	--
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	: -- :	1,650 :	--
Total cost of overtime (7 months in 1943)	: 835 :	1,650 :	--

WORK UNDER THIS APPROPRIATION

Objective: The objective has been to cooperate with responsible State agencies in locating and eradicating any remaining infections of citrus canker which may occur within the United States, thus eliminating a serious introduced disease and protecting the citrus industry from excessive losses that may result.

The Problem and its Significance: Citrus canker is a destructive bacterial disease of foreign origin which attacks all parts of the citrus tree, including fruit. Fruit is made unmarketable and trees are quickly destroyed by this disease which is highly infectious and can easily be spread from tree to tree by tools, movement of domestic animals, birds, and by many other means. It may be spread long distances by movement of infected parts of the citrus trees, including fruit, and by shipments of infected nursery stock.

This disease was first found in the United States in the vicinity of Port Arthur, Texas, in 1911. It spread rapidly eastward reaching several counties in Florida in 1914 and causing important losses in some commercial producing areas. Extensive activities carried on in cooperation with Federal and State agencies involving the expenditure of approximately \$5,000,000 resulted in eradication of the disease from Alabama, Georgia, Florida, Mississippi, and South Carolina, and commercial citrus-producing areas in Louisiana and Texas. In this work several hundred thousand orchard and nursery trees were destroyed and the participating States, as well as private industry, made large contributions to the work. The disease may still persist in limited parts of Louisiana and Texas.

General Plan: (a) To inspect citrus-growing nurseries for the prevention of possible dissemination of diseased nursery stock; (b) to complete intensive reinspection of all escaped and planted host trees of the disease in limited areas in Louisiana and Texas where infections have been found in recent years; and (c) to destroy all infected trees and all abandoned and escaped host trees in their vicinity and in the environs of previous infections. The States of Texas and Louisiana are contributing to this program during the fiscal year 1944.

Examples of Progress and Current Program: To give added needed assurance that the disease does not reappear in Florida, annual inspections are made, independently, throughout the citrus area in that State by the Florida State Plant Board.

Since 1935 several million wild and abandoned host plants of no commercial importance, growing on infected properties and in their vicinities, have been destroyed through cooperation with property owners and under State authority. Particular progress was made during the period when there was an ample supply of labor employed under funds allotted for emergency relief. This work has resulted in elimination of reservoirs which might harbor infection and from which the disease might spread. During the six years prior to February 1941, infections of this disease were found on 100 properties in Texas and Louisiana. In February 1941, infections were found on only nine properties in two counties in Texas. Since that time only one infection has been found (January 1943) which consisted of an apparent recurrence of infection on a small seedling on one of the properties found uninfected in 1941.

(g) Gypsy and Brown-tail Moth Control

Appropriation Act, 1944	\$350,000
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 59,820
Total anticipated available, 1944	409,820
Budget estimate, 1945	409,320
Decrease	- 500

PROJECT STATEMENT

Project	: 1943	: 1944	: 1945	: Increase or
	:	:(estimated):	:(estimated):	decrease
1. Inspection and certifi-	:	:	:	:
cation for gypsy and brown-	:	:	:	:
tail moth control	\$107,040:	\$119,030	\$119,070	+ \$40
2. Control operations for	:	:	:	:
gypsy and brown-tail moths:	304,310:	290,790	290,250	- 540
Covered into Treasury in	:	:	:	:
accordance with Public	:	:	:	:
Law 674	400:	- -	- -	- -
Unobligated balance	139,320:	- -	- -	- -
Total available	551,070:	409,820	409,320	- 500 (1)
Anticipated deficiency for	:	:	:	:
overtime pay	- -	- 59,820	- -	:
Total estimate or	:	:	:	:
appropriation.....	551,070:	350,000	409,320	:

DECREASE

(1) The decrease of \$500 in this item for 1945 relates to overtime pay under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	- -	- -	- -
Additional funds for overtime (appropria-	:	:	:
ted, 1943, estimated supplemental, 1944;	:	:	:
and included in budget estimate, 1945)...	*\$30,837	\$59,820	\$59,320
Total cost of overtime (7 months	:	:	:
in 1943).....	30,837	59,820	59,320

* Actual appropriation was \$31,100

WORK UNDER THIS APPROPRIATION

Objective: To prevent the spread of the gypsy and brown-tail moths by artificial means by safeguarding the movement of articles which may carry these pests into uninfested areas; and to suppress the gypsy moth at the margin of the generally infested area to prevent its spread into new sections by natural means and to eradicate outlying infestations.

The Problem and its Significance: The gypsy moth and brown-tail moth are important introduced pests which have become established in the New England area. Both are vigorous defoliators feeding upon a wide variety of trees and causing great damage. The problem is, through the use of active control measures and quarantine, to keep the insects within the general area in which they occur and to prevent spread to uninfested areas, and at the same time to make intensive efforts to reduce populations in the area of general infestation, particularly in regions adjacent to uninfested areas. Important interests are affected by this problem because (a) the commercial and aesthetic value of the trees to be protected is very large, and (b) articles affected by the quarantine include nursery stock, stone and quarry products, and forest products, including Christmas trees and greenery. Inadequate control and inspection measures would endanger the value in the former group, and would almost certainly result in State embargoes on the part of States now free from these pests.

General Plan-State and Social Cooperation: Inspection and certification service is maintained from strategic points throughout the State of Rhode Island and parts of Maine, New Hampshire, Vermont, Massachusetts, and Connecticut, which comprise the regulated area. In Pennsylvania a State quarantine similar to the Federal gypsy moth quarantine is enforced in the infested area cooperatively by the Federal and State organizations. At the western edge of the generally infested area in New York and New England, there is a relatively wide strip of country which, because of the nature and type of forest growth, climatic conditions, and natural barriers, such as Lake Champlain and the Hudson River, constitutes an effective barrier to rapid development and spread of infestation. In this barrier zone intensive scouting and control work is carried on in order to locate and suppress incipient infestations and minimize the chance of a spread to the uninfested areas to the West, and to eradicate incipient infestations which may have become established west of such barrier area. Due to the discontinuance of W.P.A. in 1943, this work is carried on at present under regular appropriations only and with the active cooperation of State, county, and municipal agencies which are contributing during the fiscal year 1944 a total of approximately one million dollars.

Examples of Progress and Current Program: The work under this appropriation is conducted under two separate projects: (a) Inspection and certification for gypsy and brown-tail moth control; and (b) control operations for gypsy and brown-tail moths.

The situation under these projects is outlined as follows:

Inspection and certification for gypsy and brown-tail moth control:
There has been no important change in the area under regulation for the past five years. Increases in the amount of inspection and certification service rendered continue, with some all-time record amounts of products being certified. Methyl bromide fumigation permitted the certification of large quantities of forest products such as Christmas trees, fuelwood and cordwood that could not have been manually inspected with the inspection force available. These forest products included logs used by the Army as shoring for heavy equipment going overseas and wood entering into the manufacture of ship fenders for naval craft. The inspection of lumber urgently needed by war industries has continued at a high level. Shipments of certified lumber from the New England States reached a new high record, with a total of 26,700,000 board feet certified in a single month. Much of this lumber was certified from the area heavily infested with the gypsy moth. Lumber inspections stepped up to 245,000,000 board feet in the fiscal year 1943, an increase of 5,000,000 board feet over any previous 12-month period.

Control operations for gypsy and brown-tail moths: Of great significance is the finding, as the result of intensive surveys during the past two seasons, that infestation apparently has been eradicated in ten entire townships in Pennsylvania, involving more than four hundred square miles where many areas of infestation previously existed. The quarantine has been revised to remove those townships from regulation. Because of the discontinuance of W.P.A. during the fiscal year 1943, and due to emergency conditions resulting from the war, current efforts are limited to two major activities; namely, intensive control measures in the case of the most dangerous and threatening infestations in the barrier zone area, and the eradication of outlying infestation, including the serious one in Pennsylvania. Intensive scouting of woodlands is carried on in the infested section of Pennsylvania and in isolated points of infestation in New York State where eradication is the ultimate objective. Less intensive surveys also are conducted in and near the western margin of general infestation in the New England-New York area to locate infestations which represent an appreciable hazard of spread. Such infestations are controlled by destroying the egg clusters by treating them with creosote or by spraying the foliage with insecticides to kill the caterpillars. Demonstrations have shown that insecticides can be applied on forest tracts with autogiros and airplanes more rapidly and economically than is possible with ground spray equipment. It is planned to stress the aerial method of control in subsequent seasons. Special emphasis is given to a method of survey to locate outlying infestations by the use of material attractive to male gypsy moths. Approximately 4,000,000 acres were surveyed by this method during the past summer. During the year scattered infestations were located by this method of survey in an area centering around Albany, Schenectady, and Saratoga Springs in New York State, and eradication work in cooperation with that State is under way in accordance with a mutually approved work program.

(h) Dutch Elm Disease Eradication

Appropriation Act, 1944	\$333,330
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 56,700
Total anticipated available, 1944	390,030
Budget estimate, 1945	300,000
Decrease	- 90,030

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Dutch elm disease eradication:				
(a) Scouting to locate trees infected with Dutch elm disease	\$267,260	\$290,530	- -	-\$290,530
(b) Identification of disease in trees suspected to be infected with Dutch elm disease	26,100	29,200	\$ 12,000	- 17,200
(c) Enforcement of quarantine in Dutch elm disease	10,480	11,750	11,750	- -
(d) Coordination of State work on Dutch elm disease	26,100	29,200	- -	- 29,200
(e) Removal of diseased, dead and dying trees	10,480	11,750	- -	- 11,750
(f) Investigations and surveys on virus disease of elms prevalent in the Ohio Valley	20,939	17,600	10,000	- 7,600
(g) Surveys to determine where the Dutch elm disease occurs as a basis for quarantine enforcement	- -	- -	203,250	+ 203,250
(h) Experimental control work to determine what action may be taken by cooperating agencies to protect valuable elms in areas of general infection	- -	- -	63,000	+ 63,000
Covered into Treasury in accordance with Public Law 674	1,600	- -	- -	- -
Unobligated balance	816	- -	- -	- -
Total available	363,775	390,030	300,000	- 90,030(1)

Transferred to "Salaries and:	:	:	:
expenses, Office of Admin-:	:	:	:
istrator, Agricultural	:	:	:
Research Administration":	+ 4,000:	- -	- -
Anticipated deficiency for	:	:	:
overtime pay	- -	- 56,700	- -
Total estimate or	:	:	:
appropriation	367,775:	333,330	: 300,000

DECREASE

(1) A decrease of \$90,030 due to the proposed revision of the work program for the fiscal year 1945, as discussed in the following paragraphs:

Under the new program, the old projects "Identification of disease in trees suspected to be infected with Dutch Elm Disease" and "Investigations and surveys on virus disease of elms prevalent in the Ohio Valley" will be continued, while those on "Coordination of State work" and "Removal of diseased, dead, and dying trees" will be discontinued. Scouting work will go on, but for quarantine rather than control purposes, and the old project "Scouting to locate trees infected with Dutch Elm Disease" will be succeeded by the project "Surveys to determine where the Dutch Elm Disease occurs as a basis for quarantine enforcement". There will also be an entirely new project covering work to be done in experimental control areas, as discussed in detail in a following paragraph.

The Agricultural Appropriation Act for 1944 authorizing Federal participation in the Dutch elm disease control program contains the following language:

"Provided, That no part of this appropriation shall be expended in any State subsequent to the final adjournment of any session of the legislature thereof which shall have begun subsequent to the enactment of the Department of Agriculture Appropriation Act, 1944, unless the laws of such State contain provisions, deemed adequate by the Secretary, requiring the owners of elm trees suffering from the Dutch elm disease to remove and destroy the same without expense to the Federal Government:"

In connection with this new proviso, the House Appropriations Committee report on the 1944 bill stated that "it is the intention of the committee to continue this limitation in the bill in subsequent years, so that, beginning with the fiscal year 1945 and thereafter, this provision should be effectively operative". (Report No. 354, House of Representatives, 78th Congress, 1st Session, page 10)

The situation with regard to legislative sessions in the several States concerned has not been such that these States have had an opportunity to act in cases where new legislation would be necessary. The revised program for the fiscal year 1945 is predicated on the assumption that the States concerned will take the necessary action

to meet the requirements of the language quoted above. It should be pointed out, however, as indicated in the following paragraphs, that definite assurance on this point has not been forthcoming from State officials who have been consulted and that, as a matter of fact, action would be required by States falling within two categories: First, those which now have within their boundaries infections of Dutch elm disease; and, second, those which do not now have such infection but in which Federal activity is necessary in order to make the surveys that are essential to effective quarantine action.

This prohibition on the use of Federal funds, except in States requiring that removal costs be borne by individual property owners, has been brought to the attention of the cooperating States. Correspondence and informal discussion with the appropriate officials of these States indicate (a) that some of the States now have laws which apparently meet the requirements; (b) that the laws of at least two of the States in which the disease is now known to occur may need some amendment to meet the requirement; (c) that in none of the cooperating States in the generally infected area is there a disposition on the part of the enforcing officials definitely to commit themselves to require removal and destruction of diseased elms solely at the expense of the property owners. The officials in some States informally indicate a willingness to try to get the trees out by persuasion, in some by payment of part or all costs with State, county, or local funds, but in general, these officials have no assurance that State laws will be enacted or existing legal authority used to enforce tree-removal at the expense of property owners. The basis of the cooperative suppressive program heretofore in effect has been the location and prompt removal of diseased elms whether trees of high value on residential property or weed trees unwanted by anyone. In view of the above, it is obvious that the Department cannot expend its own funds for these purposes.

If the formal position of the State officials with respect to the provision in the appropriation language sustains their informal expressions, it appears that all Federal expenditures for all Dutch elm disease suppressive work will be terminated in some of the States concerned. This applies also to activities other than tree removal. For instance, the discharge of the Department's responsibilities under the Plant Quarantine Act of 1912 are now made subject to the attitude of the State with respect to the removal of diseased elm trees at the owner's expense. The Federal Dutch elm disease quarantine, which does not involve removal of diseased trees but which helps to meet a Federal responsibility to States in which the disease does not now occur, cannot be maintained under the existing language of the appropriation in a State where the law does not provide for the removal of trees at the expense of property owners.

It is believed that work to combat the disease should be continued, and the program proposed for the fiscal year 1945 provides for (a) surveys to determine where the Dutch elm disease occurs as a basis for quarantine enforcement; (b) experiments to determine action that may be taken by individuals, municipalities, or other political units to protect valuable elms from this disease when it occurs generally in surrounding territory; (c) the operation of a laboratory to

culture elmwood and insect specimens suspected of being infected or contaminated with the organism as a service to individuals, municipalities, or States that elect to undertake protection of their elms, and to make determinations that are basic to the intelligent application of quarantine regulations; and (d) continuation of investigations in connection with the phloem necrosis of elms.

The first of these objectives--Surveys to determine where the Dutch elm disease occurs as a basis for quarantine enforcement--will require careful scouting in territory bordering the known disease area in order to secure information as to its spread. It will be necessary that the scouting include observations outside and beyond the known isolated outbreaks such as those existing in the vicinity of Indianapolis, Indiana; Athens, Ohio; and Cumberland, Maryland. To keep fully informed as to where the disease occurs, provision is made for periodic observations in areas where it has been eradicated since control work was undertaken, such as Preston, Connecticut; Cleveland and Cincinnati, Ohio; Brunswick and Baltimore, Maryland; and Norfolk and Portsmouth, Virginia.

The second objective contemplates large-scale field experiments to determine what action, if any, may be taken independently by individuals, municipalities, or other political units, to protect valuable elms from this disease when it occurs generally in the area. Bark beetles that serve as vectors of the Dutch elm disease are known to fly from two to three miles in search of food or suitable wood in which to multiply. Under normal circumstances, however, it is believed that their movements are restricted to one-quarter to one-half mile. It is proposed, therefore, in cooperation with interested States and municipalities to undertake experiments to determine the practicability of protecting elms in a few selected areas by applying methods known to be effective in reducing the beetle population within a generally diseased area and to determine the applicability under these conditions of methods of combating the disease. This will develop information on the practicability and probable cost of these methods should a local agency elect to adopt them. At least one such experimental area should provide for the prompt removal of diseased trees, and trees or parts of trees susceptible to beetle breeding. This plan contemplates that diseased trees which should be removed as part of the experiment will not be taken out at Federal expense. Before entering on a program involving diseased tree removal in a given area it will be necessary to have an understanding with the State, counties, or municipalities or with private individuals to absorb any expense connected with this phase of the work. Several years may be required to determine the effectiveness and practicability of this type of treatment.

The third objective is the operation of a laboratory to culture samples of elmwood and insect specimens suspected of being infected or contaminated with the organism carrying the Dutch elm disease. It is necessary to culture the fungus to identify the disease in order to provide the basic information that is needed to complete survey data as a basis for quarantine enforcement. This is also essential to the experimental protection of high value trees. The

laboratory would be continued very much as heretofore. Specimens taken from trees suspected of having the disease and bark beetles collected in the areas currently receiving attention, are submitted daily for prompt laboratory culture and determination. It is proposed also to continue the service work heretofore extended to interested individuals, municipalities, and States not equipped to make laboratory determinations of the presence of the disease in suspect material.

The fourth objective provides for continuing investigations to determine the relation of insects to the spread of phloem necrosis of elms.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	: \$19,144*	: - -	: - -
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	: 11,300	: \$56,700	: \$43,350
Total cost of overtime (7 months in 1943):	: 30,444	: 56,700	: 43,350

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To suppress, and prevent the spread of, an introduced and destructive fungus disease, known as Dutch elm disease, and to conduct control investigations on an important virus disease of elm prevalent in the Ohio River Valley, thus protecting elms of the country.

(The effective date of the provision in the Agricultural Appropriation Act for the fiscal year 1944 with respect to the use of Federal funds for the removal of trees affected with the Dutch elm disease is associated with sessions of the legislatures of the States concerned held subsequent to its enactment. During the last half of the calendar year 1943 and the calendar year 1944 few of the legislatures of the States concerned meet in regular session and the time is being used to consult with the States on changes in the objective and plan of operation that may be required. Discussions with the States are under way; also a study of their laws to determine their adequacy with respect to the provision in the 1944 Agricultural Appropriation Act. So far as is known the only States concerned in which regular legislative sessions will occur in the calendar year 1944 are the States of New Jersey and New York where the legislatures will meet early in the year.)

The Problem and its Significance: The Dutch elm disease is caused by a fungus to which all native elm species are susceptible and for which there is no known curative treatment. The fungus is carried to healthy trees and other elm material and to new areas by bark beetles which develop in elm in which the disease organism occurs.

From the discovery of the Dutch elm disease in Ohio in 1930 to November 30, 1943, over 66,800 elms affected by the disease have been located. Diseased trees have been found in a major region involving adjoining parts of New Jersey, New York, Connecticut, Pennsylvania and Massachusetts. In addition, outlying or isolated disease centers have been found in Ohio, Maryland, Indiana, Virginia, West Virginia, New York and Pennsylvania. The elms in 13 other States have been exposed to the disease through the movement of imported burl elm logs that were infected, or are threatened by spread from established disease areas. Under the new objective and work program, the hazard of intensification of the disease and its spread to new areas can be expected to increase due to the suspension of efforts at control.

The elm virus disease, which is prevalent in the Ohio River Valley, has killed many elms in various sections of that region, but its great destructiveness seems to be somewhat localized.

The American Elm, which is generally accepted as this country's most important shade tree, is susceptible to attack by the Dutch elm disease. It has been estimated that there are over 25,000,000 elm shade trees in the United States and that the real estate value of the shade trees alone exceeds \$660,000,000. This figure does not include the timber, cordwood, and other conservation values of farm and forest elms. Furthermore, the elms of America have values which cannot be measured in dollars; such as value for sentimental or historical reasons, and for special size and beauty. The death of America's elms would be a serious community loss, and would mean the destruction of an irreplaceable national asset. Their death would develop a tremendous cost through the necessity of removing millions of elms from along highways, streets and roadways and from lawns and parks, as a personal safety and property protection measure.

General Plan: Work on the Dutch elm disease consists of (a) scouting for diseased and bark beetle infested elm in known and possibly infected areas; (b) identifying the disease organism by laboratory culture tests; (c) destroying diseased and bark beetle infested material before it serves as a source of spread; and (d) endeavoring to restrict the transportation of disease material from infected to uninfected sections of the country.

In the past, appropriations for the Department, as well as allotments of W.P.A. funds, have been used but the work has been largely financed from W.P.A. funds. The cessation of W.P.A. as of January 1943 reduced materially the work that can be done.

State and Local Cooperation: The work is conducted in cooperation with the States involved and is supported by State funds in varying amounts in the States where the disease has been found. During the fiscal year 1943 the financial support by all States amounted to about \$134,000. An unknown amount of money and effort is expended by county and municipal governments and other interested parties.

Examples of Progress and Current Program: On July 1, 1942 the major region of known infection included approximately 11,745 square miles, involving the adjoining portions of Connecticut, Massachusetts, New

York, New Jersey and Pennsylvania. As of June 30, 1943, the area was approximately 12,878 square miles. Between December 1941 and January 1943, all W.P.A. projects closed. This cessation of W.P.A. activities, coupled with a reduction in the number of employees, has seriously handicapped progress. A border zone around the major region approximately 20 miles deep has been scouted as thoroughly as available resources would permit. The diseased trees found and a limited amount of bark beetle material were removed from most of this border zone. More thorough scouting and removal work was done in and about the isolated infection areas in Ohio, Maryland, Indiana, West Virginia, New York and Pennsylvania. Light surveys were carried on in areas around Boston, Massachusetts; Rochester, New York; the Ohio River Valley and a portion of the lower Mississippi River Valley; the Potomac River Valley and part of the Chesapeake Bay area; and the old infection centers at Cincinnati and Cleveland, Ohio; Baltimore and Brunswick, Maryland; and Portsmouth and Norfolk, Virginia.

During the fiscal year 1943 a total of 1,369 diseased trees were found among 12,735 specimens cultured at the laboratory. The number of specimens collected and diseased trees confirmed in this period was about two-thirds of the number for the fiscal year 1942. During the first five months of the fiscal year 1944 a total of 1,178 diseased trees was found among about 7,300 specimens cultured. Because of the nature of the work during the coming 7 months of the 1944 fiscal year, the increase in these figures for 1944 is not expected to be in proportion to the part of the year represented. The smaller number of diseased trees found during each of the last 3 years does not indicate an improved disease condition and cannot be compared with the annual totals for the calendar years prior to 1941. The smaller number of diseased trees found is a reflection of a reduction in the amount of scouting, involving elimination of work within portions of the major region where the disease is known to occur.

During the fiscal year 1943 the size of the major region and associated areas increased by 1,621 square miles. No serious extensions were made this year by finding established isolated centers. Along the margin of the major region one tree was found at Westfield, Massachusetts at some distance from any established infection, and a considerable spread northward occurred at Albany, New York. The increase in disease area seems largely due to current and recent spread found through scouting the border zone around the major region.

During the fiscal year 1943 the results of scouting at most of the isolated areas showed continued improvement. No diseased trees have been found in Cincinnati, Ohio, since 1930; none in Brunswick, Maryland; Cleveland, Ohio; or Portsmouth, Virginia since 1935; none in Norfolk, Virginia since 1936; and none in Cumberland, Maryland; Wiley Ford, West Virginia; nor in Baltimore, Maryland since 1941. Reductions in the number of diseased trees found during the calendar year 1943 as compared with the calendar year 1942 occurred at Wilkes-Barre, Pennsylvania; Athens, Ohio; and Indianapolis, Indiana. The Athens, Ohio; and Binghamton, New York isolated areas both show significant extension of the disease to new areas and definite intensification of the disease seems to have occurred at Binghamton.

During the fiscal year 1943 the amount of sanitation work, involving the removal or pruning of diseased trees and bark beetle material, was greatly reduced as compared with the fiscal year 1942. During the fiscal year 1943 the total of trees removed and pruned was 19,071 as compared with a total of 111,093 trees removed and pruned during the fiscal year 1942. Of these all but about 1,100 of the 1943 fiscal year total were removed by W. P. A.

(i) Phony Peach and Peach Mosaic Eradication

Appropriation Act, 1944	\$ 87,090
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	12,250
Total anticipated available, 1944	99,340
Budget estimate, 1945	99,340

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. Phony peach and peach mosaic eradication:				
(a) Nursery inspection and certification for phony peach eradica- tion	\$22,810	\$ 26,860	\$ 26,860	- -
(b) Orchard inspection and control for phony peach eradication ...	67,986	72,480	72,480	- -
Covered into Treasury in accordance with Public Law 674	520			
Unobligated balance	874			
Total available	92,190	99,340	99,340	- -
Anticipated deficiency for overtime pay	- -	- 12,250	- -	
Total estimate of appropriation	92,190	87,090	99,340	

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$ 5,844	- -	- -
Additional funds for overtime (appropria- ted, 1943, estimated supplemental, 1944; and included in budget estimate, 1945) ...	- -	\$12,250	\$ 12,250
Total cost of overtime (7 months in 1943):	5,844	12,250	12,250

WORK UNDER THIS APPROPRIATION

Objective: To cooperate with State and local agencies in controlling and eradicating infections, and in preventing the spread of phony peach and peach mosaic, two destructive virus diseases of peaches.

The Problem and its Significance: Production of peaches is an important industry extending to 40 States, with an average annual farm value in excess of \$50,000,000. These diseases dwarf trees, reduce production, and render fruit of little economic value. More than 54,000 orchard trees were found infected with these diseases in 1943. Their habit of natural spread from tree to tree, from orchard to orchard, and over long distances through the medium of nursery stock shipments places their control beyond the ability of individual growers.

General Plan: In cooperation with States, to inspect host trees; to secure removal under State authority of those found infected; to inspect nurseries and budwood sources and their environs, and make recommendations to the States relative to certification of those nurseries found free of disease; and to assist State officials in enforcing quarantines.

The program followed for the past several years is predicated on (a) protection of nurseries by rigid annual inspections to prevent local or long-distance spread of the diseases to new or cleaned-up areas through the medium of nursery stock; (b) eliminating the last traces of the diseases from counties or States in which only light infections remain; and (c) protecting, insofar as practicable, commercial areas in order to permit economic peach production, and to reduce and ultimately eradicate the disease from such areas.

During the fiscal year 1944, cooperating States are contributing in excess of \$37,000 to phony peach and peach mosaic eradication.

Examples of Progress and Current Program: Protection is being afforded to the peach industry within the limit of available funds. All commercial peach-growing nurseries in the infected areas, comprising more than 258, which grow in excess of $5\frac{1}{2}$ million trees were inspected during 1943, and with the exception of four nurseries, all of these met the certification requirements of the standard State quarantines relating to these diseases, thus making their stock safe and eligible for interstate movement. This accomplishment reduces the hazard of artificial spread of these diseases to new or cleaned-up areas.

Reduction in the Phony Peach Disease: Since 1936 when overall delimiting surveys were made, there has been a substantial and progressive reduction in the incidence of the disease. No phony diseased trees have been found for a period of three years or more in the six previously infected states of Indiana, Kentucky, Maryland, North Carolina, Oklahoma and Pennsylvania.

The disease has been drastically reduced in 8 of the 10 remaining infected States as indicated below:

<u>State</u>	<u>No. of Trees Infected</u>		<u>Reduction Percent</u>
	<u>1936</u>	<u>1943</u>	
Illinois	26	0	100
Louisiana	4960	44	99
Mississippi	1635	20	99
Tennessee	922	17	98
Texas	4153	68	98
Missouri	219	14	94
Arkansas	1047	129	88
South Carolina	<u>479</u>	<u>100</u>	<u>80</u>
Total	13,441	392	98

The successful eradication since 1936 of the phony peach disease entirely from six States, and its reduction by 98 percent in the eight remaining periphery States have made it possible this year to attack intensively the problem of eradicating the disease from the two remaining heavily infected States of Georgia and Alabama. In 1936 a total of 154,315 diseased trees was located and removed in these States. Suppressive measures have continued each year since that time.

During the 1943 season now closing a complete inspection of all commercial orchards and areas in these two States (Georgia and Alabama) was made. This revealed a total of 46,057 infected trees as compared to 154,315 in 1936.

The appreciable reduction in the incidence of the disease in these States this year as compared with 1936 indicates the practicability of ultimate eradication through the continuance of concentrated efforts similar to those conducted this year.

Progress of Eradication of Peach Mosaic Disease: Peach mosaic disease has been discovered in seven States. Eradication is in progress in five of these; namely, Texas, Colorado, California, Utah, and Oklahoma. Only regulatory control to prevent dissemination of the disease is in progress in the two remaining States of Arizona and New Mexico in which no commercial plantings exist, and the disease is incipient in occurrence. The following table indicates progress in eradication.

<u>State</u>	<u>Maximum Number Diseased Trees in Peak Year</u>	<u>Diseased Trees Found in 1943</u>	<u>Percent Reduction</u>
California	(1939) 37,658	1,434	96
Colorado	(1935) 32,098	3,305	90
Texas	(1937) 9,940	121	99
Utah	(1936) 1,082	140	88
Oklahoma	(1941) <u>460</u>	<u>132</u>	<u>72</u>
Total	81,238	5,132	94

In addition to greatly reducing the incidence of the disease throughout the infected areas of these States, it has been apparently eradicated from eleven counties of the total of fifty two counties originally infected.

Surveys made throughout the remainder of the peach-growing areas of the infected States and many other peach-growing States to determine the possible existence of the disease have been negative.

(j) Forest Insects

Appropriation Act, 1944	\$150,000
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 22,000
Total anticipated available, 1944	<u>172,000</u>
Budget estimate, 1945	<u>172,000</u>

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. Investigations on forest insects:	:	:	:	:
(a) Investigations of insects attacking mature timber and development of control methods	\$46,500:	\$24,100	\$ 24,100	- -
(b) Investigations of insects attacking plantations and second growth timber and development of control methods	46,500:	38,950	38,950	- -
(c) Investigations of insects attacking forest products and the development of control methods ..	10,180:	11,630	11,630	- -
(d) Investigations of termites and the development of control methods ..	31,500:	20,920	20,920	- -
(e) Investigations of insect vectors of forest tree diseases and development of control methods for these vectors	15,700:	17,400	17,400	- -
(f) Surveys to locate and determine the status of insect pests on Federal and private forest land and the formulation of advice to the land managing agencies on planning and conducting necessary control work	51,804:	59,000	59,000	- -

Unobligated balance	14,596:	- -	:	- -	:	- -
Total available	206,780:	172,000	:	172,000	:	- -
Anticipated deficiency for	:	:	:	:	:	:
overtime pay	- -	-22,000	:	- -	:	:
Total estimate of	:	:	:	:	:	:
appropriation	206,780:	150,000	:	172,000	:	:

Statement of Overtime Costs

	:	1943	:	Est. 1944	:	Est. 1945
Overtime absorbed	:	:	:	:	:	:
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945...	:	:	:	:	:	:
	:	\$ 7,431*	:	- -	:	- -
	:	7,100	:	\$ 22,000	:	\$ 22,000
Total cost of overtime (7 months in 1943):	:	14,531	:	22,000	:	22,000

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To devise the most effective and economical methods of preventing or controlling insect damage to forest trees and forest products, especially those that are of critical importance in the war effort; to make surveys to determine the status of insect infestations and ascertain where control programs are needed; to advise forest-managing and wood-using agencies on control methods and aid them with technical advise and supervision.

The Problem and its Significance: Insects affecting forests and forest products are estimated to cause losses in excess of \$100,000,000 annually. This destruction is of particular importance at present because of the greatly increased demands for lumber and other forest products used to meet war demands. Our reserve supply of standing timber and the tremendous quantities cut for lumber and other purposes must be protected from insect attack.

Losses caused by forest insects are much smaller than they would be if it were not for the advice given to forest-managing agencies and wood-using industries in applying control measures. Wartime construction activities, particularly of the Army and Navy have developed many new problems and accentuated several of those already under study and for which reasonably effective preventive or control measures have been developed.

General Plan: The work is organized on a regional basis with 10 field laboratories each of which gives attention to the most important research and service problems of its surrounding area. Emphasis is placed upon active cooperation with other federal, State and private agencies. Studies that will not result in information of immediate

practical application are being curtailed for the present. The funds and personnel so released are being devoted to problems that affect the supply of commercial timber needed for war uses. This has resulted in active cooperation with many other Federal agencies such as the War and Navy Departments, several branches of the National Housing Agency, War Production Board, and Lend-Lease Administration.

Examples of Progress and Current Program: The work under this appropriation was considerably modified in the fiscal year 1943 in order to place the greatest possible emphasis on investigations which will give immediate aid in our war effort and it is being continued along the same pattern during the current year. The work has been directed into those activities having to do with (a) conservation of timber resources and increased production of lumber; (b) cooperation with the federal housing agencies and the War and Navy Departments and War Production Board by giving advice on prevention of termite damage to housing construction and to wood substitutions for metals for use in the Tropics; and (c) efforts to improve and make more effective the work of certain large control programs, such as the gypsy moth and Dutch elm disease projects. Other activities have been held in abeyance or reduced to a mere maintenance basis so as to not lose all that has been put into them heretofore.

The interest manifested by federal and private timberland owners in the so-called sanitation-salvage logging of trees susceptible to insect attack in the mature ponderosa pine stands of eastern California and Oregon has been maintained and further applications of this method have been put into effect. The method has been particularly adaptable to the present demand for increased lumber production stimulated by war needs. These high risk trees, which are selected for cutting, yield a higher percent of the lower grades used by war industries and at the same time the reserve stands are protected from bark beetle epidemics. As a result stands will be left in a more productive condition and a larger supply of high grade lumber will be available to meet the post-war market. Additional studies were conducted during the year and are being continued in appraising the value and relative importance of the tree characters indicative of high susceptibility to beetle attack. The success of this system depends on making available practical marking rules, which can be readily applied by foresters in the employ of Federal and private agencies.

Bark beetle detection surveys, which serve as the basis for recommendations for insect control work to administrators of national forests, national parks and Indian lands as well as private companies, were continued but less area covered because of smaller appropriations. Approximately 10 million acres were covered in general observational surveys and about 100,000 acres of sample plots were intensively cruised. In the ponderosa pine forests of California and Oregon the losses have been the lowest of the past 25 years, dropping to about 500 million board feet from a high of 3.3 billion in 1932. This low loss is entirely offset by growth. Mountain pine beetle infestations in the Central Rocky Mountain Region have, under the influence of continued control work, reached a low level. These infestations in lodgepole pine in the Wasatch mountains of Utah were treated mostly

by the orthodichlorobenzene-fuel oil mixture which was perfected a few years ago and now has been shown to be entirely practical for large-scale control projects.

The spruce bark beetle has suddenly appeared in very destructive form on several national forests in Colorado. On the Clinetop Mesa of the White River National Forest where \$36,000 was spent in building an access road with the expectation of removing about 40 million board feet of timber, over 75 percent of the trees were attacked and killed this year. Surveys in other areas are under way and preliminary figures indicate a loss on this one forest of at least 125 million board feet valued at \$375,000 stumpage, in a stand of about 4 billion board feet.

Protection of war materials and construction against termites called for considerable effort during the year. Engineers, architects and contractors affiliated with federal agencies were advised on measures to be taken to afford adequate protection against termite damage to emergency war housing construction, camps and portable shelters. Frequent conferences on the detailed plans of the buildings were necessary to make effective suggestions for corrective measures. Marked improvement of design has resulted. These several Service commands of the Army were advised on the location of our field laboratories and personnel on whom they could call for consultation; and in cooperation with their engineers revised specifications were drawn up for all types of construction involving wood. Active assistance has been given at several Army posts in planning and applying control measures for serious termite infestations.

Soil poisons which have been under experimentation for a number of years proved to be a practical and low-cost means of termite prevention in the case of cheaper buildings. Considerable aid was given on the suitability of Central American woods for use in temporary construction of bridges on the Inter-American Highway. Accelerated tests were carried on at our experimental base on Barro Colorado Island, Canal Zone, and the results made available to the engineers of the Army and the Bureau of Public Roads.

Many reports of termite damage to military fabrics used in tropical campaigns came to our attention. In cooperation with the Bureau of Human Nutrition and Home Economics; Bureau of Plant Industry, Soils and Agricultural Engineering; and the Southern Regional Research Laboratory at New Orleans, a number of fabrics treated with chemicals that retard fungi were tested against termites and the results made available to the Army and manufacturers.

The research work conducted by this Division designed to increase the effectiveness of the Bureau's control programs against the gypsy moth and Dutch elm disease continued along the same lines as last year. At New Haven, Connecticut, studies of the gypsy moth were conducted and at Morristown, New Jersey, vectors of the Dutch elm disease were under observation. Great improvement is recorded in the use of trapping methods designed to detect the presence of the gypsy moth in outlying areas where the insects are very scattered. These traps have proven reliable and effective particularly as a supplement to scouting by experienced men.

Insecticidal studies have shown that cryolite has certain advantages over lead arsenate (which is limited in supply) and in addition is practically non-poisonous to domestic animals in the quantities applied. Barbed wire fencing of sprayed areas is not necessary where cryolite is used in the control of the gypsy moth.

Encouraging results have been obtained for controlling the Dutch elm disease through destruction of the vectors rather than by felling and burning the diseased trees. Improved methods of trapping the vectors received considerable attention and satisfactory results have been obtained with chemically treated trap trees. These attract the beetles and kill them as they bore under the bark. Several large areas are being tested for the use of this technique as a means of protecting cities and park areas.

(k) Truck Crop and Garden Insects

Appropriation Act, 1944	\$282,340
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 44,000
Total anticipated available, 1944	<u>326,340</u>
Budget estimate, 1945	<u>326,340</u>

PROJECT STATEMENT

Project	: 1943	: 1944	: 1945	: Increase or
	:	:(estimated):	:(estimated):	decrease
1. Truck crop insect inves-	:	:	:	:
tigations	\$239,735:	\$266,995	\$266,955	: - -
2. Tobacco insect investi-	:	:	:	:
gations	64,087:	59,345	59,345	: - -
3. Insects affecting green-	:	:	:	:
house and ornamental	:	:	:	:
plants	30,650:	- -	- -	: - -
Covered into Treasury in ac-	:	:	:	:
cordance with Public Law	:	:	:	:
674	500:	- -	- -	: - -
Unobligated balance	4,048:	- -	- -	: - -
Total available	<u>339,020:</u>	<u>326,340</u>	<u>326,340</u>	: - -
Anticipated deficiency for	:	:	:	:
overtime pay	- - :	-44,000	- -	: - -
Total estimate or	:	:	:	:
appropriation	<u>339,020:</u>	<u>282,340</u>	<u>326,340</u>	: - -

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	\$8,358*	- -	- -
Additional funds for overtime (appropria-	:	:	:
ted, 1943, estimated supplemental, 1944;	:	:	:
and included in budget estimate, 1945 ...	<u>15,000</u>	<u>\$44,000</u>	<u>\$44,000</u>
Total cost of overtime (7 months in 1943)	<u>23,358</u>	<u>44,000</u>	<u>44,000</u>

WORK UNDER THIS APPROPRIATION

Objective: To devise safe, simple, and practical methods of controlling insects affecting vegetables, sugar beets, and tobacco as an insurance against insect losses and as an aid to maximum crop yield under war-time conditions.

The Problem and its Significance: To meet increased production goals for vegetables, sugar beets, and tobacco, crops must be protected from insect attack and damage. Wartime shortages of insecticide materials, labor, and machinery have demanded modifications of insect-control practices and an intensification of the research on insect problems to provide the grower, processor, and victory gardener with means and remedies of preventing losses from insect pests. This work involves (a) the development of insecticides to supplant those of foreign origin and those needed in the production of munitions of war; (b) the prevention of losses both in quantity and quality of food through insect infestations; (c) the safeguarding of the health of the consumer from poisonous residues; and (d) the protection of crops in new areas where insect conditions are obscure factors in relation to crop production.

General Plan: Preliminary stages of the work on insecticides or remedies consist of field plot and laboratory experiments where information is gathered on the efficacy of the chemical to the insect, the proper dilutions, the effect of the chemical on the plant growth, the relation of plant growth to the time of application of the remedy to avoid poisonous residues and the cost and most efficient method of application considering weather factors. Following this preliminary work, the remedy or method of control is applied to commercial acreages in cooperation with State agricultural experiment stations, State departments of agriculture, growers, canners, and processors in order to determine its practicability under the various crop conditions encountered in this country. Work is being conducted in seventeen States, as follows: Pacific Northwest (Washington, Oregon, Idaho, Utah); Southwest (California and Arizona); Middlewest (Ohio, Nebraska, and Wisconsin); Southern and Eastern States (Louisiana, Florida, South Carolina, North Carolina, Virginia, Maryland, and Tennessee); Northeast (Maine).

The work is organized under two projects: (a) "Truck Crop Insect Investigations" which involve a study of the control of vegetable and sugar beet crop pests, and subterranean insects, such as wireworms, and mole crickets; and (b) "Tobacco Insect Investigations" which involve studies of tobacco crop pests, from seed bed to storage.

Examples of Progress and Current Program: The current program has been designed to meet the following situation:

The plant insecticides, rotenone roots and pyrethrum, were rapidly becoming perfected and universally used as insecticides for many

vegetable pests. The advantages that the rotenone and pyrethrum insecticides have over the previously widely used arsenical compounds lay in the fact that they were toxic to many vegetable pests and at the concentrations and quantities used for the control of these pests no residues were left on the plant that would in any way affect the health of man. With the outbreak of the war with Japan the supplies of rotenone and pyrethrum from the Malay Straits and Japan respectively were, of course, cut off and we are now dependent upon supplies of this material from South America where it is obtained in its wild state and the collection of the roots is in competition with the collection of wild rubber. Also the shipping situation has prevented supplies of this material which have been collected from reaching this country in quantities sufficient for our needs. The pyrethrum supplies which now come from Kenya Colony of South Africa are now practically all used for military purposes. In order to maintain our normal food supply and produce the extra amounts needed in times of war, it is essential that the insect pest be controlled and it is necessary to conserve our rotenone and pyrethrum supplies and to develop substitutes for these materials as well as others as rapidly as possible.

The program thus is directed at the development of new insecticides and the increasing of the efficiency of prewar ones, so that the limited supply may be used to the best possible advantage. It also involves investigations of methods of soil treatment and cultural control. Surveys are made of current conditions of insect infestation, in order to have at hand authentic information for use in advising those agencies charged with the most advantageous placement and utilization of supplies of insecticides and insecticide-applying equipment.

Investigations are under way against insect pests of beans, peas, potatoes, tomatoes, cabbage and other cole crops, lettuce, onions, field tobacco, stored tobacco, sugar beets, and vegetables grown for seed. The following accomplishments are examples of current contributions to agriculture under this appropriation:

Truck crop insect investigations: Investigators working on this project have found more compatible diluting agents than have been used heretofore, as well as "activators" for rotenone roots, which have resulted in supplies of rotenone roots being extended to a greater usage. The value of cryolite as a substitute insecticide for the arsenicals in the control of certain vegetable and tobacco pests has been more clearly defined. A new remedy, a dinitro compound, has been developed for the control of the bean leafhopper. The usefulness of sulfur as opposed to a pyrethrum-sulfur combination for insect pests of sugar beets grown for seed has been demonstrated and the results of this phase of the problem can be, with modification, applied to the protection of other vegetable seed crops. A wartime control schedule is being rapidly worked out for use against cabbage worms in the southern producing areas, to replace the former schedule which was seriously disarranged because of shortage of rotenone and lack of pyrethrum. An effective bait which has been used successfully over

large areas for mole crickets which infest certain areas of the Southeast has been developed. A new chemical has been tested for wireworms which shows more favorable characteristics as a soil fumigant than many others tested heretofore. Working in close contact with several States and other Government agencies, information has been obtained and supplied on several major insect pest infestations as related to the immediate need for insecticides and insecticide machinery. This service has had the effect of having insecticides available when and where such were needed for crop protection.

Tobacco insect investigations: Special progress has been made in the development of a poisoned bait feeder or trap for the hornworm moths. The general application of this trap will result in the saving of arsenic and reduce the objectionable residue hazard. Measures have been provided to the growers to reduce flea beetle infestations by the elimination of the breeding areas of these pests. The control of the green June beetle larva in tobacco plant beds has been accomplished by the development of a poisoned bait.

(1) Cereal and Forage Insects

Appropriation Act, 1944	\$350,170
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 52,700
Total anticipated available, 1944	402,870
Budget estimate, 1945	403,370
Increase	+ 500

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Cereal and forage insect investigations	\$359,016	\$372,460	\$372,960	+\$500
2. Sugarcane insect invest- igations	27,912	30,410	30,410	- -
Covered into Treasury in ac- cordance with Public Law 674	2,800	- -	- -	- -
Unobligated balance	4,267	- -	- -	- -
Total available	393,995	402,870	403,370	+ 500 (1)
Transferred to "Salaries and expenses, Office of Admin- istrator, Agricultural Research Administration" ..	+ 3,000	- -	- -	
Anticipated deficiency for overtime pay	- -	- 52,700	- -	
Total estimate or appropriation	396,995	350,170	403,370	

INCREASE

(1) The increase of \$500 in this item for 1945 is for overtime pay required under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	: \$ 5,369*	: - -	: - -
Additional funds for overtime (appropri-	: :	: :	: :
ated, 1943, estimated supplemental, 1944;	: :	: :	: :
and included in budget estimate, 1945)...	: 22,600	: \$52,700	: \$53,200
Total cost of overtime (7 months in 1943):	: 27,969	: 52,700	: 53,200

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To discover and improve methods for the control of insect pests of corn, sorghums, sugarcane, small grains, soybeans and forage crops, including grasses, clovers and alfalfa, during their growth in the field and during their storage and processing after harvest, and to make known control and preventive measures less expensive and more effective under existing conditions so as to insure adequate supplies of food and feed to meet war needs.

The Problem and its Significance: These crops are attacked by many different insects. Although they are the most essential and valuable crops grown, their acre value is low. Cost of control measures for pests attacking them must therefore also be low. Estimates of the average annual losses caused by some of the more important of these insects are given below. With the special need due to war, and world conditions, of adequate supplies of these staple food and feed crops, the importance of finding and improving means of preventing these losses is unusually urgent. Satisfactory control measures have not yet been found or fully developed for many of the more injurious species and the need of modifying or substituting other control measures has been made urgent by soil conservation practices, emergency storage of food reserves, and scarcity of insecticides and fumigants due to their preemption for war activities.

<u>Insect</u>	<u>Crop</u>	<u>Average annual loss</u>
Earworm	Corn	\$79,000,000
Hessian fly	Wheat	13,000,000
Chinch bug	Corn, sorghum & small grains	15,000,000
Grasshoppers	Cereal and Forage	25,700,000
Grain and flour weevils and moths	Stored grains and cereal products	366,000,000
Alfalfa weevil	Alfalfa	891,000
Alfalfa caterpillar	"	750,000
European corn borer	Corn	17,000,000
		(Loss in 1942 including only the surveyed portion of the infested area.)
Sugarcane borer	Sugarcane	7,716,000 (1942)
" "	Corn	2,576,000
" "	Rice	500,000
Rice stink bug	"	3,000,000

General Plan: In cooperation with other Departmental agencies, State experiment stations, farmers, warehousemen and millers, to continue investigations now in progress at 20 field stations in strategic locations throughout the continental United States, to determine the habits, status as vectors of plant diseases, distribution and abundance of, and losses caused by, the insect pests of cereal and forage crops, and with this information as a basis to devise practicable measures of control through the adjustment of cultural and storage practices, development of resistant crop varieties or cheap, easily applied insecticides and fumigants, and, particularly in the case of accidentally introduced foreign pests, the introduction and dispersion of their natural enemies. The work is divided into two financial projects, as follows: (a) Cereal and forage insect investigations, and (b) sugarcane and rice insects. The program of work under this appropriation has been subject to constant review and rearrangement in order to insure maximum attention to war-connected objectives.

Examples of Progress and Current Program: Most of these investigations, such as the breeding of resistant crop varieties, ecological studies to discover cultural methods of control, including beneficial crop rotation and practical field trials of these methods, require rather long terms of years of connected observations for the attainment of decisive results. However, while progress is necessarily gradual, indefinite results are achieved each year. The more important of the current results are outlined in the following sections:

Cereal and forage insect investigations:

Hessian fly: Severe infestations of the 1943 crop developed in eastern Kansas and Central California. A club type wheat, Poso 42, into which a high degree of resistance to the hessian fly as well as desirable agronomic qualities has been bred, in cooperation with the Bureau of Plant Industry, Soils and Agricultural Engineering and the California State Agricultural Experiment Station, was released to California growers in 1942. The supply is still limited, but the variety is fulfilling its early promise. Another variety, Big Club 43, possessing resistance to stem rust, bunt and root rot, as well as the hessian fly, is being increased for immediate release in California. Other new varieties having high resistance to the hessian fly and various diseases are well advanced toward release in Kansas and Indiana.

Chinch bug: Weather conditions during spring and early summer of 1942 and 1943 served to suppress impending severe infestations in the Central States, and research work on this insect was correspondingly reduced. Owing to prospective shortage of coal tar creosote in 1942 a number of other chemicals were tested as possible substitutes. Several of these were found quite promising, notably a dust containing dinitro-orthocresol.

Corn earworm: A study made in the Boise Valley of Idaho, where the bulk of the seed sweet corn for the country is produced, and where this insect causes serious losses, demonstrated that a single treatment by the oil-pyrethrin method of control for the earworm in market sweet corn is effective and practicable for the protection of sweet corn grown for seed against this pest.

Pyrethrins having become scarce because of war conditions a search has been made, with some promising results, for satisfactory substitutes for use in earworm oil.

Material resistance to the corn earworm in certain lines of field and sweet corn has been found in comparative federal and State investigations in Illinois, Indiana, Maryland and Mississippi.

The pea aphid, which causes extensive annual losses of early alfalfa cuttings is being controlled through the use of highly aphid-resistant selections of alfalfa. Additional information has also been obtained on the physiological characters responsible for this resistance. This work is being continued with a good prospect that it will result in desirable aphid-resistant varieties.

The sweet clover weevil, has recently become injurious in the North Central States. In preliminary experiments good control was obtained on newly-sown sweet clover with a DM-sulphur dust but this work has been dropped for lack of funds.

Thrips continue to be mainly responsible for the widespread injury to young peanut plants, known as "pouts." The habits of the species involved are being determined and insecticidal treatments are being tested.

Grasshoppers: The downward trend in grasshopper abundance which began in 1939 has continued into 1943, although control measures have been necessary in many areas in the Central and Western States.

Due to the wartime need of bran for stock feed, its scarcity and high price, and the scarcity and high price of sawdust, emphasis is being placed on the testing of bran and sawdust substitutes in grasshopper bait. • Cottonseed hulls with millrun bran or with wholewheat flour, and new sawdust in place of the aged sawdust formerly considered necessary, gave equally good results in field trials. If larger scale work confirms these results, it may be possible to use cheap, low-grade flour in grasshopper control in place of high-priced bran needed for stock feed.

Field studies on the habits of grasshoppers indicate the possibility of preventing outbreaks of certain species in certain areas by baiting them while concentrated either as egg-laying adults or as recently-hatched nymphs on the restricted areas where they have been found to lay their eggs. Large-scale tests of this procedure have been conducted in 1943.

Horned cricket: Field trials indicated that steam-rolled wheat can be substituted with excellent results for standard bran in horned cricket baits. The use of cheap, low-grade wheat for this purpose instead of high-priced and much-needed bran may thus be practicable. Field trials showed that savings can be made in control operations by adjusting the dosage per acre in accordance with the density of cricket populations by means of strip baiting.

A study of 4 major outbreaks has shown that extensive losses of crops and large sums spent for control resulted from the spreading of original small infestations in mountainous areas. These losses probably could have been prevented by prompt application of modern control methods at a small fraction of the expenditures actually made.

Current plans call for the surveillance of these and other areas, with the cooperation of ranchers, with a view to preventive control at small cost as compared with control after infestations have become widespread.

White grubs: Beginning with 1940 data have been obtained indicating that, contrary to general belief, the June beetles, which are the parents of white grubs, lay their eggs about as freely in legumes as in blue-grass turf. Most of the grubs hatching from eggs laid in sweet clover, however, died rather quickly, apparently because of unfavorable soil and moisture conditions. The use of deep-rooted legumes in the cultural control of white grubs is thus indicated. Although fully satisfactory control measures for white grubs have not yet been perfected the bulk of the work is being suspended because of reduced infestations and curtailment of funds.

White-fringed beetle: Damage to field and garden crops was greater in 1943 than in any year since 1937 in the Florala, Alabama area, and the area known to be infested has been much extended, especially in North Carolina.

Larval survival has been much lower in heavy soils than in more sandy soils. Damage to crops has been less where heavy vegetation was plowed under than in more barren soil, apparently because the larvae feed to a considerable extent on the decaying plant material instead of the living plants. These facts may be of practical value in cultural control. Crop rotations conducive to reductions in beetle populations and damage have been tentatively determined from plot experiments and recommended. Further information on cultural and other control measures applicable by the individual farmer is needed, however.

Legume seed crop pests, including lygus spp., stink bugs, seed chalcid and others, continue to reduce greatly the production of alfalfa seed in the Rocky Mountain States. Control of these insects by cultural measures has been found effective in southwestern Arizona when applied on a community scale. The efficiency of these measures when applied on individual farms in that and other areas is now being investigated.

Observations have indicated that part of the lowered production is due to a scarcity of the wild bees and other insects that act as flower pollinating agents. Ways of increasing pollination by artificially increasing the abundance of wild bees and by the utilization of domestic bees are therefore being investigated.

The vetch bruchid, has greatly reduced the production of hairy vetch seed in the South Atlantic States and has recently caused large losses in the Willamette Valley of Oregon where the bulk of this seed crop is now produced. A survey in 1943 incidental to plans for increasing the production of hairy vetch seed needed for cover crops in the South, revealed the presence of this bruchid in northern Georgia, Alabama and Mississippi. Rotenone dust, which had been found to give fair control, having become scarce, tests of many other insecticides to find an

effective substitute have shown that a sweetened poison bait spray is quite promising. It is planned to continue the investigation of this and other insecticides.

Insects attacking rice in field: In studies of varietal resistance to the rice stink bug, Rexoro and Fortuna showed less injury than Early Prolific and Zenith varieties.

Field plots treated with acid phosphate and ammonium sulphate to overcome losses due to the water weevil-rootrot complex showed an average increase in yield of 5.8 bushels per acre over untreated plots.

Examinations indicated that the growing of rice and sugarcane in adjoining fields does not increase the sugarcane borer infestation in either.

Except for a lack of satisfactory control measures for the stink bug, fairly complete information on the importance, biology and control of the major insect pests of growing rice has been obtained and published. Due to there being no immediate prospect of finding a good method of controlling the stink bug and to reduction in funds for 1944 the investigation of the insect pests of growing rice has been discontinued.

Insects attacking stored grains and grain products: Laboratory tests showed several materials, especially white lead paint, to be highly effective in preventing the cadelle and other grain-infesting insects from burrowing and surviving for months in the woodwork of bins to attack clean grain that may be placed in them.

It was found that the fumigants methyl bromide, chloropicrin and carbon disulphide materially reduce the germination of wheat having a moisture content of over 13 percent and thus should be used with caution. Several promising substitutes have been found for the common grain fumigants which are subject to wartime scarcity.

The insect infestation was effectively kept down in a flour mill in which a general fumigation was followed by local fumigation of conveyors every 3 weeks and weekly removal of stock from elevator boots to determine the efficiency and economy of this treatment.

Both empty freight cars and those loaded with flour were successfully fumigated with methyl bromide at 6 pounds per car for control of flour-infesting insects.

Due to the continued occurrence of urgent insect problems in stored grain and milled cereals and the wartime need of conserving these staple foodstuffs these investigations are being continued on the same scale as heretofore.

European corn borer: The European corn borer caused losses of field and sweet corn totalling over \$17,000,000 in 1942. These were considerably greater than in any year since its discovery in the United

States. Its dispersal was recorded in 1943, as far west as central Iowa and Missouri in the main Corn Belt. Studies of the factors affecting corn borer abundance indicate that when fields containing corn residues were plowed before moth emergence and planted to cultivated crops such as soybeans, only about one-fourteenth as many borers survived in them as in fields where uncultivated crops followed corn. These results point toward the desirability of following corn with a cultivated rather than a non-cultivated crop such as wheat or oats, as a borer control measure.

In commercial-scale trials of derris spray and dual-fixed nicotine dust at costs of \$19 to \$24 per acre these treatments showed a net profit of about \$400 per acre due to reduction of borer infestation and increased yields of early market sweet corn. Wartime scarcity of the recommended insecticides has intensified the need of the search now in progress for satisfactory substitutes. Several have been found of some promise but need to be further tested.

The utilization in the corn-breeding program of borer-resistant strains of corn have been intensified during the past year. Several fairly resistant strains of both field and sweet corn have been found. This is considered one of the most promising lines of investigation and is being continued.

Four species of imported parasites have now become abundant in certain areas of the Northeastern States and their combined effects have resulted in a mortality of as much as 40 percent of the borers in appreciable areas. Colonization of these parasites in new areas is being actively continued.

Sugarcane insect investigations:

Sugarcane Borer: Observations in 1942 indicated that this borer reduced the yield of sugar from sugarcane in Louisiana by 226,000,000 pounds. In southern Florida the borer infestation in 1942 was much lower than usual, apparently as the result of heavy parasitization by 3 introduced species of parasites.

Field experiments have shown that the borer may be controlled effectively and profitably by four applications of cryolite dust at weekly intervals during the egg-hatching period of the first or second generation. This treatment has come into use on about 10,000 acres in 1943.

Of 4,582 seedling varieties tested during the past 6 years four gave resistant progeny. Three varieties have been selected as parental material for breeding because of their consistently low infestation.

In view of the wartime need of stimulating domestic sugar production, work on the development of cultural insecticidal and biological control measures for the borer, and of borer-resistant cane varieties, is being continued on the same scale as heretofore.

Other insects attacking sugarcane: Intensive efforts during 1941 and 1942 to eradicate the West Indian sugarcane mite at Canal Point, Florida have apparently been successful since none of these mites could be found in that locality in August 1942. This was the only known infestation left in the United States.

At the Sugar Plant Field Station, Cairo, Georgia, no infestation of the sugarcane mealybug was found on plantings where the seed cane had been treated with hot water.

The West Indian sugarcane fulgorid was observed to be somewhat more numerous in 1942 at Canal Point, Florida than in 1941, but it was heavily parasitized. This species was also present in very small numbers at Cairo, Georgia.

In order to further the investigation of insecticidal control of the sugarcane borer as most important to the war effort it was necessary to limit the program of work on insects that carry important sugarcane diseases. No work was done on the insect vectors of sugarcane mosaic. Limited experiments were conducted on the transfer of chlorotic streak disease from plant to plant by the sharpnosed leafhopper without decisive results.

(m) Barberry Eradication

Appropriation Act, 1944	\$223,250
Anticipated deficiency for overtime pay required by the War	
Overtime Pay Act of 1943	+ 35,220
Total anticipated available, 1944	258,470
Budget estimate, 1945	<u>258,470</u>

PROJECT STATEMENT

Project	: 1943	: 1944	: 1945	: Increase or
	:	:(estimated):	:(estimated):	decrease
1. Barberry eradication:	:	:	:	:
(a) Eradication of the	:	:	:	:
barberry in the 13	:	:	:	:
States where work was	:	:	:	:
begun in 1918	: 165,357	: \$219,000	: \$219,000	: - -
(b) Eradication of the	:	:	:	:
barberry in other	:	:	:	:
States	: 25,950	: 34,750	: 34,750	: - -
(c) Inspection of nur-	:	:	:	:
series which ship bar-	:	:	:	:
berries interstate.....	: 4,553	: 4,720	: 4,720	:
Covered into Treasury in	:	:	:	:
accordance with Public	:	:	:	:
Law 674	: 600	: - -	: - -	: - -
Unobligated balance	: 510	: - -	: - -	: - -
Total available	: 196,970	: 258,470	: 258,470	: - -
Transferred to "Salaries	:	:	:	:
and expenses, Office of	:	:	:	:
Administrator, Agricul-	:	:	:	:
tural Research Adminis-	:	:	:	:
tration"	: + 3,000	: - -	: - -	:
Anticipated deficiency	:	:	:	:
for overtime pay	: - -	: -35,220	: - -	:
Total estimate or	:	:	:	:
appropriation	: 199,970	: 223,250	: 258,470	:

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	: *\$ 2,331	: - -	: - -
Additional funds for overtime (appropri-	:	:	:
ated, 1943, estimated supplemental,	:	:	:
1944; and included in budget estimate;	:	:	:
1945)	: 14,000	: \$35,220	: \$35,220
Total cost of overtime (7 months	:	:	:
in 1943)	: 16,331	: 35,220	: 35,220

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To prevent widespread and costly damage to crops of wheat, oats, barley and rye through the control of black stem rust in the principal grain-producing areas of the United States by eradicating the rust-spreading barberry bushes.

The Problem and its Significance: Wheat, oats, barley and rye are grown on 75,000,000 acres in the 17 States of the barberry eradication area and yield an average annual production of 1.5 billion bushels of grain valued in excess of \$800,000,000. The control problem involves the location and eradication of the rust-spreading barberry, Berberis vulgaris, in the grain-growing States and of the native barberries, B. fendleri and B. canadensis, in the grain-producing areas of western Colorado and of Virginia and West Virginia, respectively.

The common barberry is an introduced shrub that was brought to this country by the early settlers and became more or less generally established throughout the United States through planting and escaping from cultivation. It became widely distributed in the principal grain-producing regions, in farm yards and timbered areas, along stream banks and fence rows, and in other uncultivated lands. These barberries and the native species of the Virginias and Colorado are a serious hazard to the annual production of small grains and consequently to the Nation's food supply.

Stem rust is the most destructive of all diseases that attack wheat, oats, barley and rye. It is caused by a fungus that lives alternately on barberries and on grains and wild grasses. The rust is spread by wind-borne spores that are produced on these plants. In the northern States, the fungus overwinters in the black stage on grain stubble, straw, and wild grasses, and in the spring spreads to barberry bushes. After a short period of growth on the barberry, it spreads to nearby wild grasses and grains, where the red stage develops. In this stage the rust spreads from plant to plant and from grain field to grain field over extensive areas. These local outbreaks sometimes merge, causing regional epidemics of great destructive power that severely damage grain crops after the principal cost of production has been incurred. As the grain reaches maturity, the black stage appears on the ripened straw and grasses. Not all kinds of barberries are susceptible to the disease. The eradication of susceptible plants and prevention of their further distribution in cooperating States gives protection to the grain.

The significance of barberries as a source of local stem rust epidemics can be observed annually in grain-producing areas where these bushes are present and cause excessive losses by interfering with the growth and development of small grains. Under such conditions, crops are often repeated failures because of stem rust infection. Thousands of these local outbreaks of the disease have

been eliminated by eradicating barberries. As a result, many areas where stem rust caused partial or total losses aggregating millions of dollars are now producing profitable crops.

The eradication of barberries has another important value to grain producers and dependent industries because these bushes are a source of new and potentially destructive races of the stem rust fungus. Just as there are many varieties of wheat, oats, barley and rye, there likewise are many varieties and races of the stem rust fungus. Certain varieties of grain are highly resistant to some of these races and very susceptible to others. New races develop by hybridization on the barberry and old ones are perpetuated on these bushes. About 180 different races of the stem rust fungus have been identified but only a few of them appear during any one year. The eradication of barberries reduces the opportunity for the perpetuation of existing races and the production of new races of the fungus that may attack new and improved resistant varieties of grain. Barberry eradication also removes the source of local rust epidemics.

General Plan-State and Local Cooperation: Barberry eradication is carried on by the Bureau of Entomology and Plant Quarantine in cooperation with 17 States. Close working relations are maintained with interested federal, State and local agencies, including those engaged in breeding new and improved rust-resisting grains. Within the States the work is organized under State leaders, who plan, direct and coordinate the activities of all cooperating agencies so as to clear definite areas of barberries. Timbered areas, stream banks, fence rows, and other uncultivated lands are systematically examined for barberries and the infested areas are mapped. The bushes are eradicated by treating them with salt or other chemicals, or by grubbing. Initial eradication is carried on in unworked areas. Previously treated areas are reworked as needed at about 6-year intervals until all danger of regrowth from sprouts and seeds has passed. Surveys are conducted each year to determine where and to what extent stem rust is causing damage to grain crops. The distribution and planting of susceptible barberries in cooperating States is prevented by quarantine regulations. Nurseries are encouraged to grow only immune varieties for the trade and to cooperate voluntarily in eliminating their rust-susceptible barberries. The eradication program is supplemented by educational work to inform property owners about stem rust and its control and to obtain their active cooperation in locating and destroying barberry bushes.

Examples of Progress and Current Program:

Eradication of barberry in the 17 cooperating States: During the calendar year 1942, the demand for men by war industries and the armed forces resulted in the termination of the emergency relief program, so that no further funds were available from that source for barberry eradication work. Field operations were adjusted to

meet these conditions by a drastic reduction in personnel employed on the project, by using available labor in areas where rework would give the greatest returns in crop protection, and by giving attention to large areas initially worked with emergency relief labor, so as to protect the investment already made in barberry eradication by federal, State and local cooperating agencies.

Cooperative barberry eradication work was performed during 1942 in areas aggregating 23,579 square miles in 17 States, and 15,240,787 barberry bushes were destroyed on 2,576 properties. Also, 6,346 properties previously cleared of bushes were checked for seedlings and regrowth, and 4,943 of these were found to be free of barberries.

Crop and weather conditions during the 1942 growing season were generally favorable for the development of stem rust, as evidenced by the widespread prevalence and severity of other diseases, such as leaf rust of wheat, crown rust of oats, and flax rust, all of which became epidemic in some areas. However, losses from stem rust, with but few exceptions, were confined to grain-producing areas still infested with barberries. Damage was negligible except for certain localities in west-central Missouri and in Virginia and West Virginia where average losses ranged from 5 to 10 percent. The light stem rust infection throughout most of the control area is attributed largely to the absence of inoculum. One of the important factors responsible for this condition is the large reduction in the number of barberry bushes which serve as early sources of stem rust in the northern grain-producing States.

Inspection of nurseries that ship barberries interstate: Applications were received from 72 nurseries in 1942 for permits to ship species of Berberis and Mahonia other than B. thunbergii into the States protected by the quarantine. Permits were granted to 61 applicants, 10 were refused because susceptible barberry bushes were found growing on their properties, and in one case a permit was not needed since the nursery was producing only the immune species B. thunbergii. A total of 6,856 susceptible barberry plants were eradicated in 20 different nurseries. Nursery owners in States outside the eradication area were encouraged to voluntarily eliminate susceptible species of barberry from their nursery stock. At least 13 of these nurseries destroyed their susceptible barberry bushes during 1942, and a number of others expressed their willingness to cooperate in this work. The inspection of nursery stock has resulted in almost complete elimination of susceptible barberry bushes from nurseries located within the 17 States participating in barberry eradication work and from many nurseries outside the eradication area that have listed from one to several susceptible species of barberry in their catalogues in recent years.

Status of barberry eradication work: The area designated for barberry eradication in the 17 States of the control area comprises 1,005,825 square miles. As a result of the work already completed,

658,775 square miles, or about two-thirds of the area, has been placed on a maintenance basis and will require only a limited amount of work in the future. This includes nearly all of South Dakota and Wyoming and more than 78 percent of the area comprising the States of Montana, Missouri, Nebraska, North Dakota and Indiana. There are 347,051 square miles largely in States bordering or east of the Mississippi River where barberries remain widely distributed, and systematic survey will be necessary to accomplish their eradication. In these areas barberries became widely established before control work was undertaken, and repeated inspections of infested areas will be necessary to eliminate bushes that develop from the seed of the original barberries.

Since the eradication program began, barberries have been found on 127,527 properties, and of this number 40,592 are now on a maintenance basis requiring little or no further work. Many of the remaining 86,935 properties will be placed on maintenance after one more inspection, but a large portion of them are in the generally infested area and continued effort will be necessary to prevent reinfestation.

The accomplishments during 1942 and the status of the barberry eradication work are shown in the following tables:

Barberry Eradication

Table 1 - Accomplishments in barberry eradication during the calendar year 1942

State	Area surveyed: (sq. miles)	Properties cleared of barberries	Bushes destroyed		Salt Used (Tons)
			Berberis vulgaris (Number)	Native Species (Number)	
Colorado	354	17	1,725	1,464,418	0.4
Illinois	1,751	45	812	-	2.2
Indiana	1,607	39	255	-	0.5
Iowa	1,819	162	9,926	-	15.0
Michigan	4,352	127	2,728	-	14.6
Minnesota	3,230	54	2,161	-	9.1
Montana	52	17	159	-	0.3
Nebraska	1,063	11	125	-	0.1
North Dakota	3,457	2	62	-	0.2
Ohio	550	15	1,740	-	2.6
South Dakota	367	2	27	-	0.2
Wisconsin	1,787	128	19,137	-	16.6
Wyoming	-	-	-	-	-
Subtotal	20,389	619	38,857	1,464,418	61.8
Missouri	2,167	35	269	-	0.4
Pennsylvania	880	322	426,195	-	155.3
Virginia	128	179	3	4,884,435	314.1
West Virginia	15	18	-	8,426,610	317.4
Subtotal	3,190	554	426,467	13,311,045	787.2
Total	23,579	1,173	465,324	14,775,463	849.0

Barberry Eradication

Table 2 - Status of Barberry Eradication through 1942

State	Square Miles			Number of Properties with Barberries			
	In	On	Unworked or	Cleared	On	Requiring	
	Control	Maintenance	Requiring	to	Maintenance	Rework	
	Area		Rework	Date			
Colorado	67,733	63,125	4,608	2,657	934	1,723	
Illinois	56,043	24,447	31,596	19,491	5,871	13,620	
Indiana	36,045	24,923	11,121	6,873	4,360	2,513	
Iowa	56,167	30,292	25,875	15,093	4,979	10,114	
Michigan	57,481	21,303	36,178	16,971	7,964	9,007	
Minnesota	80,883	26,458	54,425	8,790	3,625	5,165	
Montana	146,316	125,021	21,295	635	247	388	
Nebraska	77,268	62,698	14,570	4,796	3,761	1,035	
North Dakota	70,183	54,990	15,193	1,074	694	380	
Ohio	40,740	18,603	22,137	16,919	4,067	12,852	
South Dakota	76,868	71,524	5,344	1,493	1,124	369	
Wisconsin	54,852	12,355	42,497	16,808	2,883	13,925	
Wyoming	94,487	94,371	116	125	50	75	
Subtotal	915,066	630,110	284,955	111,725	40,559	71,166	
Missouri	37,570	20,247	17,323	1,338	33	1,305	
Pennsylvania	27,073	4,261	22,812	8,652	--	8,652	
Virginia	11,821	1,416	10,403	3,786	--	3,786	
West Virginia	14,295	2,738	11,558	2,026	--	2,026	
Subtotal	90,759	28,664	62,096	15,802	33	15,769	
Total	1,005,825	658,774	347,051	127,527	40,592	86,935	

(n) Cotton Insects

Appropriation Act, 1944	\$140,730
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 23,000
Total anticipated available, 1944	<u>163,730</u>
Budget estimate, 1945	<u>163,730</u>

PROJECT STATEMENT

Project	1943	1944 (esti- mated)	1945 (esti- mated)	Increase or decrease
1. Cotton insect investiga- -tions:				
(a) Boll weevil control in- vestigations of	\$48,000:	\$49,607:	\$49,607:	- -
(b) Boll weevil control on Sea Island Cotton, inves- tigations of	6,500:	6,325:	6,325:	- -
(c) Pink bollworm inves- tigations	29,500:	32,600:	32,600:	- -
(d) Bollworm investiga- tions	10,000:	12,725:	12,725:	- -
(e) Plant bugs affecting irrigated cotton, investi- gations of	10,500:	17,400:	17,400:	- -
(f) Cotton fleahopper and related insects, investi- gations of	17,500:	13,350:	13,350:	- -
(g) Cotton aphid investi- gations	15,685:	22,158:	22,158:	- -
(h) Investigations of var- ious cotton insects	6,179:	7,415:	7,415:	- -
(i) Importation of natural enemies of cotton insects..	1,712:	2,150:	2,150:	- -
Covered into Treasury in ac- cordance with Public Law 674	300:	- -	- -	- -
Unobligated balance	5,063:	- -	- -	- -
Total available	<u>150,939:</u>	<u>163,730:</u>	<u>163,730:</u>	- -
Anticipated deficiency for overtime pay	- -	-23,000:	- -	
Total estimate or appropriation	<u>150,939:</u>	<u>140,730:</u>	<u>163,730:</u>	

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$7,600	- -	- -
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	2,500	\$23,000	\$23,000
Total cost of overtime (7 months in 1943)	10,100	23,000	23,000

*Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To develop new methods and improve the present means of controlling insects attacking cotton, which in turn will increase the supply of fiber, feed and food, lower the cost of production, and increase the farm income. During the war there are several special objectives:

- (1) To develop methods of conserving insecticides containing essential materials needed in the war effort, such as copper, arsenic, and rotenone;
- (2) To increase the quantity and quality of long staple cotton urgently needed for war purposes;
- (3) To develop methods of control to reduce the use of dusting and spraying machines so that essential metals used in their manufacture can be used in war industries;
- (4) To keep the War Food Administration, War Production Board, Office of Price Administration, and other war agencies, the cotton growers, insecticide manufacturers and others interested in cotton production accurately informed concerning cotton insect conditions, so that insecticides and machinery may be available in the areas where needed.

The Problem and its Significance: Cotton is a crop which supplies food, feed, and fiber, and is becoming increasingly important as the war progresses. More than 11,000 items are made wholly or in part of cotton for the armed forces. Cotton is not just fiber. With each 500-pound bale of fiber there is produced 900 pounds of seed which yield

140 pounds of high grade vegetable oil for food
 400 pounds of protein meal and cake for livestock feed
 240 pounds of hulls for livestock roughage and chemical uses
 81 pounds of linters for powder, plastics, and other products.

The curtailment of importation of vegetable oils has increased the need for cottonseed oil. Cotton seed is the largest domestic source of vegetable oil for shortening, salad oil, and other food items, and for making soap, glycerin, paint, and many other essential products. Cotton seed also provides 2,000,000 tons of meal and cake, or approximately one-third of the United States' production of protein feed and 1,000,000 tons of roughage for the production of milk and beef. Cotton linters or the fuzz from the seed are a source of cellulose for smokeless powder, waterproofing, non-breakable glass, synthetic fabrics, plastic, replacements for metals and numerous other products.

Insect damage continues to be the principal hazard to increased cotton production and takes an annual toll of 15 to 20 percent of the crop. While the reduction in insect losses in 1943 to lower levels than in the past several years was due largely to weather conditions unfavorable for insects and favorable for cotton, it was also due to better distribution of information on the damage being caused by insects in different sections, and to more effective use of insecticides.

General Plan: Field and laboratory experiments are conducted in cooperation with State experiment stations, other federal agencies and farmers. Research laboratories are located in regions where serious cotton insect problems occur in South Carolina, Georgia, Mississippi, Louisiana, Texas, and Arizona. New insecticides are tested in the laboratory and in field cages against various cotton insects and the materials that show promising results are then tested under field conditions. Studies of the life history and habits of insects are made as a basis for developing control and suppressive measures, and for preventing spread to new areas. Records are made of the seasonal abundance and damage of insects in different areas and timely information on control is furnished to the farmers.

As an aid to the federal and State entomologists in keeping informed on cotton insect conditions, cooperation of the farmer crop reporters of the Bureau of Agricultural Economics, the members of the 4-H Clubs, vocational agricultural teachers, ginners, farmers, and others is obtained in making weekly reports on insect abundance in their localities. Such information obtained from many sources enables the Bureau to keep the War Food Administration, War Production Board, Office of Price Administration, insecticide manufacturers, and cotton growers informed concerning cotton insect conditions.

Examples of Progress and Current Program: The research program on cotton insects has been modified to obtain information of immediate value in meeting changing conditions during the emergency. Special attention was given in 1943 to enlarging the survey on cotton insect conditions. The more than 30,000 reports on insect damage to cotton, obtained through the cooperation of various agencies furnished the most complete picture of insect conditions ever obtained and enabled the Bureau to furnish prompt and accurate information to the War Food Administration, War Production Board and the Office of Price Administration, manufacturers and distributors of insecticides, dusting and spraying machinery,

and other agencies as an aid in distributing insecticides and dusting machinery to the areas where they were most needed. Fortunately there were sufficient supplies of calcium arsenate and sulfur, the two principal insecticides used against cotton insects, to meet the demands, and the information obtained from the survey enabled shipments to be made to different areas at the time when they would do the most good. The survey also enabled the State and federal entomologists to furnish farmers timely information on control measures and availability of insecticides in their States. Its educational value in arousing the interest of farmer and club boy cooperators in using control measures will be of permanent value.

Assistance was rendered the airplane dusting industry in locating surplus motors, repair parts, and mechanics and pilots for the maintenance and operation of airplanes engaged in dusting cotton for insect control. Airplane dusting assisted in overcoming the farm labor shortage for insect control because of the large acreage that can be dusted by a small number of specially trained pilots.

A new method of insect control by chemical defoliation of the cotton plants before frost is being investigated. In some tests dusting with a small quantity of cyanamid caused the leaves to drop in a few days. This is, in effect, a substitute for early fall cutting of the stalks for insect control as it stops development of the squares and young bolls in which boll weevils multiply and removes the leaves on which aphids and leafworms feed and cause staining of the open cotton. Removal of the leaves reduces the amount of trash in the lint and increases the amount of cotton that can be picked by hand per man day. Because the bolls open earlier and more uniformly, defoliation is of special importance in mechanical harvesting of cotton as it improves the quality by at least one grade and permits a larger proportion of the crop to be harvested.

War restrictions on the use of derris, cube, and other dusts containing rotenone on cotton have made it necessary to find other materials for cotton aphid control. The thiocyanates and other synthetic organic chemicals that were tested were not satisfactory for aphid control when used alone or in combination with other insecticides. Nicotine was found to be the most effective available aphicide but has not proved satisfactory under all conditions. Additional experiments are needed to test materials, determine the time of day when they can most effectively be applied and the minimum dosages that can be used for best and most economical results.

Tests this year confirmed previous results that molasses is not necessary in the mopping mixtures used for boll weevil control in South Carolina and other southeastern States. As a result of this work two to three million gallons of molasses that have been used in some of the past years can be released for making the increased quantities of alcohol needed in the war effort by substituting cornstarch, wheat flour, wall-paper paste or some of the clays for thickening the mopping mixture. Several commercial mixtures made without molasses are now on the market.

Large scale tests to determine the effectiveness of mopping entire fields for control of the boll weevil were conducted in six representative areas of the Cotton Belt. These tests showed that while mopping reduced the early season weevil populations, it did not prevent or control the heavy infestations that often occur later in the season. It has not been found as dependable a method of boll weevil control as dusting with calcium arsenate when the weevils are abundant.

Work designed to improve calcium arsenate or to find a substitute for the 70 million pounds used annually for the control of the boll weevil, bollworm and cotton leafworm is being continued. The possibility of diversion of arsenic for military purposes especially justifies continued effort to discover a substitute material. As substitutes for arsenicals, the fluorine insecticides offer the most promise. Cryolite, of which there is an abundant supply, is less effective against the boll weevil but more effective than calcium arsenate against the bollworm. It is not injurious to the cotton plant but its physical qualities need improvement to give better plant coverage. Sodium fluosilicate, a byproduct in the manufacture of phosphate fertilizer, is sufficiently toxic to give good boll-weevil control but also has very poor dusting qualities.

Preliminary laboratory and cage tests with the new organic material known as DDT have shown it has great possibilities for control of the bollworm, plant bugs, stink bugs, and thrips on cotton, but indicate little value against the boll weevil, cotton leafworm and cotton aphids. The insects for which it shows promise are among the most difficult to control of the cotton pests.

Protection of long staple cotton from insect damage is necessary in order to produce the high quality lint needed for war purposes. Control of the boll weevil and aphids on sea-island cotton in the Southeast and of the plant bugs and stink bugs on American Egyptian cotton in the irrigated sections of the Southwest continue to be important problems in long staple production. The paris green-sulfur mixture developed by investigations gave less effective control in 1943 than in previous years because of the unusual abundance of stink bugs. Although approximately 3,000,000 pounds of the paris green-sulfur and other arsenical-sulfur insecticides were used this year and gave good increases in yields and profits, a better insecticide for stink bug control is needed.

The cotton flea hopper, tarnished plant bug, rapid plant bug, and other plant bugs are often serious pests of cotton in all cotton-growing areas. Their destruction of the small squares and bolls early in the season causes reduction in yield and makes the crop later and thus more liable to injury from other insects. Sulfur and mixtures of sulfur and calcium arsenate or paris green were developed some years ago as control measures for these insects. Basic copper arsenate, a new insecticide, has given good results in preliminary tests but its production is restricted because of the war. Other new materials and combinations of materials are being tested.

The bollworm occurs over the entire Cotton Belt. It is a very injurious cotton insect, and one of the most difficult to control. Lead arsenate and calcium arsenate have for some years been recommended for the control of this insect, but recent experiments indicate that cryolite and basic copper arsenate may be even more effective.

The spread of the pink bollworm to new areas along the coast of Texas and Louisiana is a serious menace to the entire cotton industry because of the danger of this pest becoming established throughout the Cotton Belt. The most vulnerable point of attack that has been found in the life history of the pink bollworm is the resting stage that lives over winter in the crop debris or soil. Biological factors and crop practices are being carefully studied with a view to the improvement of cultural control methods. Tests of a large number of the insecticides used for other insects have not disclosed an effective control for the pink bollworm but additional new materials are being tested.

(o) Pink Bollworm and Thurberia Weevil Control

Appropriation Act, 1944	\$637,460
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 98,400
Total anticipated available, 1944	<u>735,860</u>
Budget estimate, 1945	<u>738,960</u>
Increase	<u>+ 3,100</u>

PROJECT STATEMENT

Project	1943	1944 (esti- mated)	1945 (esti- mated)	Increase or decrease
1. Pink bollworm and Thurberia weevil control:				
(a) Inspection to determine status and possible presence of the pink bollworm and Thurberia weevil within and without regulated areas	\$98,076	\$120,640	\$121,140	+ \$500
(b) Regulatory operations to suppress and prevent spread of the pink bollworm and Thurberia weevil as required by Federal Quarantines on these insects	147,663	179,700	180,450	+ 750
(c) Control operations for suppression or eradication of infestations of the pink bollworm	106,930	219,360	220,285	+ 925
(d) Eradication of wild cotton in Florida for protection of cultivated cotton from pink bollworm....	80,880	125,460	125,985	+ 525
(e) Cooperation with the Mexican Government to control pink bollworm infestations to prevent spread into the United States....	29,942	90,700	91,100	+ 400
Covered into Treasury in accordance with Public Law 674.	1,600	- -	- -	- -
Unobligated balance	16,644	- -	- -	- -
Total available	481,735	735,860	738,960	+3,100 (1)
Transferred to "Salaries and expenses, entomology and plant quarantine, Agricultural Research Administration" foreign parasites	+1,400	- -	- -	- -
Anticipated deficiency for overtime pay	- -	-98,400	- -	- -
Total estimate or appropriation	483,135	637,460	738,960	

INCREASE

(1) The increase of \$3,100 in this item for 1945 is for overtime pay required under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$30,170	- -	- -
Additional funds for overtime (appropriated, 1943; estimated supplemental, 1944; and included in budget estimate, 1945)	- -	\$98,400	\$101,500
Total cost of overtime (7 months in 1943)	30,170	98,400	101,500

WORK UNDER THIS APPROPRIATION

Objective: To prevent the spread of pink bollworm and *Thurberia weevil* from infested areas within the United States; to eradicate infestations of the pink bollworm from sections most dangerous to the main Cotton Belt and remote from the source of reinfestation; and to cooperate with the Mexican Government and local Mexican authorities in survey and control operations on the pink bollworm; thus reducing the danger of spread to cotton production within the United States from established infestations in Mexico.

The Problem and its Significance: The pink bollworm is recognized by all cotton-producing countries as the most destructive of all cotton insect pests. The menace to the cotton crop of this country has not been lessened in any particular during the cotton season just ended because a heavier infestation developed in the Lower Rio Grande Valley of Texas so early in the season as to result in spread to three new counties along the Gulf Coast of Texas and to three parishes in southwest Louisiana. The new infestation along the Gulf Coast of Texas is extremely light, being limited to a very few locations in Calhoun, Brazoria and Matagorda Counties. Infestation in Cameron Parish, Louisiana, developed rather rapidly so that a good many pink bollworms were present late in the season. These new outbreaks necessitate action sufficiently drastic to prevent the pink bollworm from becoming established in these new areas which lie close to the main Cotton Belt. The southern half of the Cotton Belt which comprises more than half of the cotton acreage in the United States is comparable to areas in other countries where the pest has inflicted considerable losses. Reports from several of the principal cotton-growing regions of the world indicate an annual average loss of more than 20 percent because of pink bollworm infestation. Its habit of feeding inside the immature cotton boll results in stained and cut fibers and a reduction of the oil content of the seed.

The Thurberia weevil is very similar in structure and in feeding habits to the common boll weevil of the South, and it has adapted itself to the arid mountain areas of Mexico and Arizona. Its native host is Thurberia cotton which grows wild in the mountain areas of that region, but it feeds and breeds freely on cultivated cotton and develops best under climatic conditions unfavorable to the true boll weevil.

The establishment of these pests in the main cotton-producing sections of our country would cause excessive losses, and would add to the losses already being caused by established insect pests, further increasing the cost of producing cotton and lowering the quality of lint, and reducing the production of seed valuable for oil, meal, and other products.

General Plan: The work consists of enforcement of the federal quarantines to prevent spread by artificial means; cooperation with the States to assure compliance with required control measures within the infested areas; conducting control operations to prevent the build-up of infestation that would cause increased damage and which would thereby increase the probability of spread to noninfested areas; eradication of infestation where practicable; and the inspection of the cotton to determine the status of infestation in areas that are now known to be infested, and to determine the presence or absence of the insects in localities in which they are not known to exist.

Full-time employees are located in Arizona, Florida, New Mexico, Texas, and Mexico, with field headquarters in San Antonio, Texas. District and sub-district stations are maintained within the regulated areas at places conveniently accessible to the growers and cotton processors and shippers. Project headquarters for the Mexican cooperative work is at Torreon, Coahuila, Mexico. The administration of the program is on a work project basis, each work project embracing a main objective of the program.

Cooperation with other Agencies and Individuals: These activities are all conducted in cooperation with State agencies, other federal agencies, farmers, agricultural associations, and organizations representing cotton growers, processors, factors and exporters, and other local agencies. An important phase is the control work carried on cooperatively with the Agricultural Department of the Republic of Mexico, which contributes the services of some 30 employees, together with equipment and incidental expenses. This work has been greatly strengthened by assignment on invitation of the Mexican authorities of Bureau personnel long experienced in pink bollworm control to the cooperative program in an advisory capacity in the interior cotton-growing regions of Mexico. A similar type of cooperation is received from the various cotton-producing States, while processors, ginnermen and farmers make substantial contributions to the work by incurring the extra expense involved in treatment of products to make them safe for movement out of the quarantined area.

sanitation of premises, segregation of products at ginning plants, destruction of cotton stalks, controlled planting and other practices, which would not be necessary in the normal course of their operations but which are willingly undertaken as a part of the effort directed against the pink bollworm.

Examples of Progress and Current Program:

Inspection to determine status and possible presence of the pink bollworm and Thurberia weevil within and without regulated areas: This portion of the current pink bollworm program continues to be of greatest interest to cotton growers of the main Cotton Belt. Careful attention is, therefore, given to inspection for the pink bollworm, first, in the regulated areas now known to be infested with the pink bollworm to determine the changes occurring in the intensity of infestations and whether any part or all of these areas can be released with safety from quarantine; and second, inspections made in areas thought to be free from the pest to determine as early as possible whether the pink bollworm has been carried to new localities, and to eradicate such incipient infestations, if any are discovered.

Principal dependence in the inspection for the pink bollworm is placed upon the use of a large number of units of gin trash inspection machines, which make it possible to give much more effective and thorough inspection of the Cotton Belt as a whole than was the case when it was possible only to conduct field inspection of cotton bolls during the growing season. However, the field inspection of cotton bolls continues to be an important supplementary method of inspection. For example, gin trash inspection in southwestern Louisiana resulted in finding one or two pink bollworms at each of four gins in three parishes. Field inspection revealed a relatively heavy infestation on about two thousand acres, involving some 350 farmers in Cameron Parish but failed to trace infestation back to the fields in Calcasieu and Jeff Davis Parishes, indicating a very light infestation in those parishes. This information permitted placing proper emphasis on control and eradication efforts in the area involved in southwestern Louisiana.

Regulatory operations to suppress and prevent spread of the pink bollworm and Thurberia weevil as required by Federal quarantines on these insects: In the regulated areas the growers and processors realize that the quarantine measures enforced by the Department in cooperation with State agencies are responsible in a considerable measure for holding in check the infestation. As a matter of fact the measures required under the quarantine for local treatment of products before permitting them to enter into the channels of trade are proving adequate in some sections, where climatic conditions are not favorable for the insect, to prevent the pink bollworm from becoming established, even though reinfestation from heavily infested areas along the Mexican border has been recurring periodically. Responsible cotton growers, processors, and others interested in the cotton industry located in the free areas feel

that the regulatory measures conducted inside the quarantined areas have prevented the spread of the pink bollworm by artificial means to their communities. Growers in free areas immediately adjacent to pink bollworm infested areas are particularly insistent upon rigid enforcement of the quarantine regulations. This is true despite the chance of spread by natural means because often wind currents are not favorable to that method of dispersal. A striking example of this fact is the continued absence of infestation in San Patricio County, a heavy cotton-growing area, which lies adjacent to Nueces County which has been infested since 1938.

Control operations for suppression or eradication of infestations of the pink bollworm: An effort was made to shorten the growing season for cotton production in the Big Bend area of Texas as a pink bollworm control measure in 1943, by the early planting of cotton to be followed in the fall by an early cleanup of the cotton plants so as to destroy any pink bollworm before they left the bolls for winter hibernation. Early planting was followed by only a part of the growers so it was impossible to obtain an early cleanup on the entire acreage. For that reason there was a late buildup of pink bollworm population indicating a heavy carry-over. Another effort was made to produce long staple cotton in this area without success and due to the fact that the long growing season required for that type of cotton results in a heavy pink bollworm buildup, its production is to be prohibited by regulation of the Texas Department of Agriculture in that small area in 1944.

Heavy pink bollworm infestation developed in the Lower Rio Grande Valley of Texas, in the central portion of Cameron County in July of this season. This heavily infested section showed distinct commercial damage and the growers and other cotton interests, upon this being pointed out to them, offered their cooperation in getting the fields cleaned up promptly after harvest of the crop. The farmers owning these heavily infested fields did cooperate and cleanup was conducted on that basis, involving cutting of stalks, raking and burning the cut stalks and debris, followed by plowing. It is believed this intensive cleanup of these heavily infested fields so early in the season--July and August--will be reflected in a reduced infestation in that section next season. Stalk destruction throughout the Lower Rio Grande Valley of Texas was not completed as early as planned due to torrential rains which prevented farmers from getting into the fields with heavy equipment.

Following discovery of a relatively heavy infestation in Cameron Parish, Louisiana, a control program was inaugurated in that area involving an intensive cleanup of the cotton fields so as to destroy as many hibernating pink bollworms as possible. Cotton stalks were cut or pulled while still green, piled and burned. There was very little shatterage of bolls but as an added precaution the farmers plowed the ground immediately so as to bury any bolls in which pink bollworms might be present, thereby hastening their rotting as that area receives heavy rains during the winter months.

The control program in the Glendale area of the Salt River Valley in Arizona following the harvest of the 1942 crop consisted mainly in extra deep plowing so as to cover cotton debris sufficiently deep to prevent emergency of moths in the early summer of 1943. There were no pink bollworms found in the Glendale section in the 1943 cotton crop.

Eradication of wild cotton in Florida for protection of cultivated cotton from pink bollworm: Negative inspection for the pink bollworm in the main cotton areas in north Florida and southern Georgia continue to give emphasis to the value of the program designed eventually to eradicate the wild cotton from southern Florida. There was no increase in the degree of pink bollworm infestation in the wild cotton plants in southern Florida during the past season. The status of the wild cotton eradication program indicates it is entirely feasible to eradicate eventually that plant from southern Florida, with consequent elimination of the threat of the spread of the pink bollworm from wild cotton to the main Cotton Belt. Increasing numbers of wild cotton locations along the West Coast of Florida between St. Petersburg and Naples are now being worked without finding plants at each inspection which bears out the foregoing statement. The program continues to emphasize the importance of maintaining pink bollworm infestation at a low enough level to prevent its spread to the main Cotton Belt pending final eradication of all wild cotton in southern Florida.

Cooperation with the Mexican Government to control pink bollworm infestations to prevent spread into the United States: It was recognized from the very inception of the program to prevent spread of the pink bollworm in the United States that the cooperation of the Mexican authorities would become increasingly important, particularly in the event that the pink bollworm spread into the Lower Rio Grande Valley of Texas and Mexico. Consequently, following the finding of pink bollworm infestation in the Lower Rio Grande Valley of Texas and Mexico in 1936, the cooperation between the Agriculture Departments of the two governments has been intensified. The Departments of Agriculture of both countries became so impressed with the importance of the control of the pink bollworm at both interior and border points in Mexico that upon request of the Mexican officials for additional technical advice and assistance an office was established in the principal cotton-growing area of Mexico, which is considered the most heavily infested pink bollworm region in all of North America. It is too early to evaluate the importance of this step in further strengthening the cooperation of the two governments, but it is expected eventually to reduce infestation at interior points as well as on the border thereby reducing the risk of spread to uninfested portions of the United States. A very early host free condition was achieved in the Matamoras region of Mexico in 1943 which ought to result in a lower infestation in that area in 1944. Joint control programs along the Mexican border are far more effective than would be the case if separate action was taken without reference to the program of the other country because the cotton area is similar on both sides of the border and, in fact, in most cases is geographically one area.

(p) Bee Culture

Appropriation Act, 1944	\$79,500
Anticipated deficiency for overtime pay required by the War	
Overtime Pay Act of 1943	+12,450
Total anticipated available, 1944	91,950
Budget estimate, 1945.....	85,000
Decrease	<u>- 6,950</u>

PROJECT STATEMENT

Project	1943	1944	1945	Increase or decrease
		(estimated)	(estimated)	
1. Bee culture	\$80,859	\$ 91,950	\$85,000	- \$6,950 (1)
Unobligated balance ...	641	- -	- -	- -
Total available	81,500	91,950	85,000	- 6,950
Transferred to "Salaries:				
and expenses, library":	+ 2,600	- -	- -	
Anticipated deficiency :				
for overtime pay	- -	- 12,450	- -	
Total estimate or				
appropriation	84,100	79,500	85,000	

DECREASE

- (1) The decrease of \$6,950 in this item contemplates the discontinuance of cooperative work on bee disease resistance which is being carried on in Texas and Iowa, and a reduction in the bee stock testing work being conducted at the Madison, Wisconsin laboratory; also a reduction of one clerical position at the Beltsville headquarters of the Division of Bee Culture.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$*4,400	- -	- -
Additional funds for overtime (appropri-			
ated, 1943, estimated supplemental,			
1944; and included in budget estimate,			
1945).....	2,000	\$12,450	\$11,400
Total cost of overtime (7 months in			
1943).....	6,400	12,450	11,400

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To make beekeeping sufficiently attractive and profitable over the widest possible area of the United States to insure that there will be no shortage of bees to pollinate the 50 or more critical agricultural crops needed in the war effort which depend on insects to set fruit or seed, and to utilize fully facilities existing for the production of honey and beeswax. The specific objectives of the research work are to reduce losses from bee diseases and adverse wintering conditions, to promote better methods of apiary management and to encourage the use of superior strains of bees.

The Problem and its Significance: Every State is more or less dependent upon honeybees as pollinating agents. Beekeeping facilitates the production of almonds, apples, pears, plums, cherries, tung, small fruits, melons, cucumbers, vegetable seeds, cotton, and the seeds of clovers and alfalfa, and aids in the maintenance of pastures and ranges. The beekeeper's income is derived from the sale of honey and beeswax, thus the successful growing of many crops is dependent upon the sale of these products. The production of beeswax, which is a critical material used in the manufacture of munitions, planes and ointments for gas burns, normally is about half the amount required for domestic use. Honey is wholesome, nutritious food much in demand during the present shortage of sugar.

Beekeeping is practiced in every State. There are in the United States more than 5,000,000 colonies, representing an investment of \$55,000,000, with an annual production of about 200,000,000 pounds of honey, 5,000,000 pounds of beeswax, and about \$500,000 worth of live bees for shipping into honey-producing areas. Field studies indicate that honeybees perform at least 80 percent of the pollination of agricultural crops worth many times the value of the foregoing apiary products.

No matter how well crops are cultivated, fertilized, and cared for, they will not produce full crops without adequate pollination. Providing bees for this purpose is the most practicable means of increasing the yields of crops already under cultivation. With the greatly increased acreages and yields necessitated by the war goals, beekeeping must be fostered in every way.

It is necessary that substitutes be found for critical materials used in beekeeping and that beginners and inexperienced persons be properly advised, that losses from disease and other causes be reduced to the minimum, that methods of beekeeping be simplified, and that high-producing strains of bees be used.

General Plan-State Cooperation: Laboratory and field experiments are conducted in cooperation with State and federal agencies. The co-operating States include Arkansas, California, Iowa, Louisiana, Oregon, Texas, Utah, Wisconsin, and Wyoming. Disease diagnosis, determination of arsenic in poisoned bees, and information through correspondence are service features made available to all. Problems arising as a result of war conditions are given special attention.

Examples of Progress and Current Program: The current program includes the determination of factors which influence the value of bees in the pollination of agricultural crops; methods of improving the production of honey, beeswax, and pollen; utilization of pollen and pollen substitutes; the testing and development of breeding stock resistant to disease and having high productivity; and surveys of the prevalence of Fosema disease in package bee areas and arsenical poisoning in fruit areas. Work is also being done in testing substitutes for critical materials used in the beekeeping industry.

The war demand for full crops of seeds and fruits has focused attention on the dependence of agriculture on the bee industry to pollinate fully the vast crop acreages. Serious unbalance between plants requiring insect pollination and wild bee population is attributed to: (a) A lack of suitable situations for nesting places brought about by an increase in land under cultivation with elimination of wood lots and other wild areas, (b) the destruction of wild bees by clean cultivation, application of insecticides, fast highway traffic, brush and other fires.

Declining alfalfa seed yields in some of the best producing areas, roughly from a maximum of 12 to 13 bushels per acre to less than 2 bushels per acre, has focused attention on the need for more pollinating insects to increase seed production. Invariably areas having an abundance of bees show higher seed production than areas in which bees are scarce. Work this past year demonstrates very strongly that by far the most feasible means to increase seed production is through the proper use of honeybees. Increasing alfalfa seed yields through the use of bees holds more hope than through better fertilization, use of improved varieties or better cultural practices.

The use of artificially inseminated queens has been limited by their low egg laying capacities. Recent refinement of instrumental technique has made practical the use of inseminated queens in field tests of disease resistant stock. This past year every colony headed by an artificially inseminated queen of resistant stock in which mating was absolutely controlled proved non-infective to American foulbrood.

Through many centuries little progress has been made in honeybee improvement because of the difficulty in controlling mating. Under natural conditions and in queen mating yards hybridization rather

than pure line breeding takes place. Through perfection of artificial mating of queens by the use of instruments, queens are now being obtained which perform fully as well as naturally mated queens. Perfection of this technique opens up unlimited possibilities for development of strains of bees especially adapted to pollination, for honey production, for resistance to disease.

Honey production in many of the northern States and supplying bees for pollination service in many areas is dependent to a marked degree upon the availability of package bees and queens from areas in the southern States and in California. The package bee business has been seriously handicapped through high losses of queens. The Bureau has demonstrated that the majority of all such queens lost prematurely are infected with Nosema apis disease. In some cases as much as 90 percent of all package bees coming from specific southern areas are infected. In colonies started with package bees the loss of the queen through this disease means the essential elimination of a colony both for honey production and for pollination of crops. The work on nosema disease so far has been confined to preliminary survey to determine losses. Essentially nothing is known as to how this disease can be controlled.

The problem of bee losses arising from the application of insecticides for crop protection has become so serious that the work program has been adjusted so as to make funds and personnel available for some study of the matter. This attention, while admittedly inadequate, will it is hoped develop some information on which a thoroughgoing study may be based.

(q) Insects Affecting Man and Animals

Appropriation Act, 1944	\$165,940
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 22,930
Total anticipated available, 1944.....	188,870
Budget estimate, 1945	175,000
Decrease	- 13,870

PROJECT STATEMENT

Project	1943	1944	1945	Increase or decrease
		(estimated)	(estimated)	
1. Insects affecting man and animals	\$148,447	\$163,130	\$149,050	-\$14,080 (1)
2. Household insects ...	22,239	25,740	25,950	+210 (2)
Covered into Treasury in accordance with Public Law 674	430	- -	- -	- -
Unobligated balance	3,989	- -	- -	- -
Total available	175,105	188,870	175,000	- 13,870
Anticipated deficiency for overtime pay		- 22,930	- -	- -
Total estimate or appropriation	175,105	165,940	175,000	

INCREASES OR DECREASES

The net decrease of \$13,870 in this item for 1945 consists of:

- (1) A decrease of \$14,080 under the project "Investigations of insects affecting man and animals" composed of:
 - (a) A decrease of \$12,591 representing a curtailment of research work on mosquitoes, being conducted at New Smyrna Beach, Florida, and the closing of the station at Panama City, Florida, which is engaged in dogfly research.
 - (b) A decrease of \$1,489 for overtime pay under the War Overtime Pay Act of 1943.
- (2) An increase of \$210 under the project "Investigations of household insects" for overtime pay required under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	: \$11,992	: - -	: - -
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945).....	: - -	: \$22,930	: \$21,651
Total cost of overtime (7 months in 1943).....	: 11,992	: 22,930	: 21,651

WORK UNDER THIS APPROPRIATION

Objective: To determine the habits of and to develop control measures for those species of insects which transmit disease, such as malaria and typhus to our armed forces and civilian population, annoy men, and attack livestock, and damage or destroy fabrics and food products, particularly the large stocks stored for use by war agencies.

The Problem and its Significance: The role played by insects in the transmission of disease to man and animals in the United States is so important as to make it imperative that the habits and life histories of these disease-transmitters be clearly understood so that control measures can be directed at the most vulnerable points in their life cycles. Malaria has always taken a tremendous toll of life, and the loss of efficiency in certain States, resulting from malaria, reaches an incalculable figure each year. Troops returning in the immediate future from malaria-infested areas will certainly add to the problems of controlling malaria, dengue, and filariasis, all carried by species of mosquitoes now within the United States.

Typhus is transmitted by body lice. All of these diseases take on new importance at the present time because of the activities and return of our armed forces from regions throughout the world where these diseases are rampant. Typhus can be controlled immediately when body lice are stamped out. Yellow fever, malaria, dengue, and filariasis are brought under control when the mosquitoes that transmit them are destroyed.

Production of beef, mutton, poultry, and wool, mohair, hides and dairy products vital to national welfare is greatly affected by the depredations of many insect pests such as screwworms, biting flies, cattle grubs, and lice. Horse-raising and farm operations are also adversely affected by insects such as horse bots, stable flies, and buffalo gnats.

It is highly important, from the standpoint of national defense, to safeguard all stocks of food, raw and finished products, blankets, clothing, rugs, and upholstery in factories and warehouses. Many millions of dollars worth of fabrics of all kinds are destroyed by clothes moths, carpet beetles, and silverfish; and great quantities of food products are ruined by flour moths, grain weevils, and flour beetles. These losses are suffered annually by procurement divisions of the federal government, warehouses, storekeepers, manufactures, and householders. The insects involved are cosmopolitan, and the losses caused by them affect every individual. Many of the methods now used in combatting these pests are outmoded and no longer adequate to meet acute and complex wartime problems.

General Plan, Including Cooperation with Federal and State Agencies and Individuals: The work consists primarily of field and laboratory experiments, frequently in cooperation with federal agencies, State agricultural experiment stations, various control or abatement districts, farmers, livestock associations, physicians, veterinarians, and similar groups. The work is done in 9 laboratories, mostly in the South where medical entomological problems are most acute. Information desired by the Army and Navy on insect repellents, louse control and malaria mosquito larvicides will be furnished mostly by Office of Scientific Research and Development, Office of Emergency Management funds since there are no regular appropriations for these studies.

The work is organized under two financial projects: (a) Insects affecting man and animals; and (b) household insects.

Examples of Progress and Current Program: The following examples of recent accomplishments under this appropriation are cited by projects to show progress in one or more aspects of the broader problems involved.

Insects affecting man and animals:

Mosquito investigations: Under cooperation with military authorities the compound of Swiss origin known as DDT has been found promising

in the control of a wide variety of insects. The work on this material as a lousicide and as an insecticide in the control of immature and mature stages of mosquitoes led to investigations in other Divisions of the Bureau where it has been tested and found effective on a number of agriculture pests. This material far exceeds paris green as a malaria mosquito control agent.

A patent application has been entered for a small and economical device which utilizes heat to liberate aerosols in camps and homes for the control of the adult mosquito. This device shows great promise, for it is known that if the malaria mosquito is prevented from biting the second time the transmission of the disease is stopped.

Extensive field tests on a wide variety of mosquito species in the Arctic and in the northwest sections of the United States were made in the repellents developed through cooperation with the Office of Scientific Research and Development. The species involved are severe biters, and some may transmit equine encephalomyelitis and human encephalitis. In one test carried on at a northern base, in which twelve enlisted men and two officers of the U. S. Army participated, it was voted unanimously that the repellents were preferred to the use of heavy clothing as a protection against mosquitoes.

A new oil emulsion mosquito larvicide containing a wetting agent was developed and released to the public in April 1943. The use of this wetting agent has been the means of saving at least 25,000 gallons of fuel oil this season by the armed forces, the U. S. Public Health Service, and several municipalities. It is stated that the added use of wetting agents during 1944 will be the means of saving from two to three-hundred-thousand gallons of fuel oil.

An entomologist has continued to serve as a liaison officer with the military and in this capacity has visited most of the important camps in the United States relative to mosquito control and other insect problems.

Ticks affecting man: A spray has been developed to control ticks about the premises of camps and bivouac areas, which will be practical, also, for use around home sites. This spray is made of nicotine sulfate and sodium fluoride, both materials which are readily available.

A certain amount of protection against ticks by means of an insect repellent, dimethyl phthalate, has been afforded military personnel on maneuvers and where ticks were unusually abundant, as, for example, Camp Bullis, Texas.

Screwworms: Information has been developed to the effect that one of the insect repellents (Indalone) can be applied to range cattle for the purpose of repelling horn flies, which are a predisposing cause of screwworm infestations.

The new insecticide DDT, when applied at intervals of two weeks as a spray to the backs of cattle as they pass through chutes, has been effective in repelling horn flies and subsequent screwworm infestations.

Research is being continued looking toward the development of a substitute for diphenylamine, a critical material.

Cattle grubs: Research has been continued for the purpose of developing an activator for rotenone in the control of cattle grubs. During the past year three such materials have been found which show promise in laboratory tests. These will be tested on animals under field conditions this season.

During the year two diluents, pyrophyllite and tripoli earth, have been recommended to the public. Where rotenone dusts are indicated for the treatment of cattle grubs, the use of these diluents will more than double the number of animals which can be treated by rotenone.

Ticks affecting animals: A tickicide in which DDT is used in a non-drying adhesive showed considerable promise in the treatment of range animals along the Gulf Coast for control of the spinose ear tick. Treatments of soil beneath feed and salt troughs in corrals suggest that this method is a promising control for spinose ear ticks, a serious menace to cattle, sheep, and goats.

Lice, mites and head bots: A promising dip for the control of the short-nosed cattle louse has been developed which can be used on cattle in the warmer parts of the United States. This dip will be tested in the field this season.

Dog flies: Indalone was found to be effective for the protection of dogs and horses against dogflies. This repellent has been recommended and is now being used in this and foreign countries by the armed forces, particularly the Coast Guard.

Household insects: Some attention has been given to research in the protection of dehydrating plants where foods are being processed for the armed forces to insure control of insect pests. Such pests as ants, flies, roaches and silverfish are important problems in dehydrating plants, and information on their control is badly needed. Temperatures for the dehydrating of foods are not high enough to kill the insects which infest the foods. The problem, therefore, is one of maintaining control of insects in these plants so as to prevent their infesting foods before packaging. Additional studies are being made for the protection of foods in which a variety of cartons, containers, and wrappings is used.

The Bureau has continued the usual inspection of Australian wool for the Federal Trade Commission, as well as testing fabrics for the American Red Cross, the Maritime Commission, the Federal Trade Commission, the Quartermaster Corps of the Army and Navy, and the Gas Warfare Office.

Storages of food supplies (such as coffee and nuts) damaged by insects have also been inspected and recommendations given for their reclamation.

(r) Insect-Pest Survey and Identification

Appropriation Act, 1944	\$130,000
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+21,550
Total anticipated available, 1944	151,550
Budget estimate, 1945	145,000
Decrease	- 6,550

PROJECT STATEMENT

Project	: 1943	: 1944	: 1945	: Increase or
	:	:(estimated):	:(estimated):	decrease
1. Insect-pest survey ...	\$7,344	\$7,970	\$7,970	- -
2. Identification and classification of insects	141,202	143,580	137,030	-\$6,550 (1)
Unobligated balance	54	- -	- -	- -
Total available	148,600	151,550	145,000	- 6,550
Anticipated deficiency for overtime pay	- -	-21,550	- -	
Total estimate or appropriation	148,600	130,000	145,000	

DECREASE

- (1) A total decrease of \$6,550 in this item for 1945 consists of:
- (a) A decrease of \$5,360 due to a reduction in the number of professional employees engaged in research in insect classification in the District of Columbia.
- (b) A decrease of \$1,190 relating to overtime pay under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	:\$2,870	- -	- -
Additional funds for overtime (appro-	:	:	:
priated, 1943, estimated supple-	:	:	:
mental, 1944; and included in budget:	:	:	:
estimate, 1945).....	8,600	\$21,550	\$20,360
Total cost of overtime (7 months	:	:	:
in 1943).....	11,470	21,550	20,360

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Insect-pest survey:

Objective: To collect, maintain, and furnish available information on the presence and abundance of insect pests.

The Problem and its Significance: To economically and effectively distribute insecticides, and to approach insect control and eradication campaigns the first requirement is a knowledge of the distribution of insect or insects in question. Many of the most injurious pests migrate from concentration points to cultivated areas, and these reservoirs must be located for successful control. Quarantines are based upon a knowledge of the distribution of foreign and domestic insect pests. Soil conservation recommendations for agricultural changes must take into account insect distribution and host plants.

General Plan: To obtain data on distribution and abundance from all available sources. This includes voluntary reporting of over 300 collaborators, consisting of field workers of the Bureau of Entomology and Plant Quarantine, State entomologists, entomologists of the agricultural experiment stations, and entomologists of plant boards. To advise, where possible, on survey methods. To prepare statements of current insect conditions as a guide to State and federal agencies responsible for or concerned with insect control and as a warning of developments of outbreaks.

Examples of Progress and Current Program: During the last fiscal year many requests were received for extensive survey information, such as: The distribution of insect vectors of tropical diseases, prepared at the request of the U. S. Army Chemical Warfare Service; a list of the insects attacking rubber-producing plants prepared for the Office of the Coordinator of Inter-American Affairs; the distribution records of the potato tuber moth and the Oriental fruit moth, prepared for two divisions of the Bureau of Entomology and Plant Quarantine, before a general survey was inaugurated; the records of the spread of a

newly-introduced Japanese weevil, prepared at the request of the Connecticut Agricultural Experiment Station; information on the localities where parasites of the sugar beet webworm were most likely to be found, prepared at the request of the Canadian Department of Agriculture, Entomological Branch; the records of the distribution of the vetch bruchid, prepared at the request of the Food Distribution Administration, before recommendations were made to extend the planting area of hairy vetch in the Gulf Region to alleviate the shortage of vetch seed. At the request of the Russian Government, a list of insects that might be introduced into Russia with seeds from the United States was checked and revised.

Insect Identification:

Objective: Identification of insects and allied organisms for the quarantine, control and research activities of the Bureau of Entomology and Plant Quarantine, the Public Health Service, and also for the benefit of the military and naval establishments and other federal agencies, State agricultural colleges and experiment stations, pest control operators and private individuals of the United States, as well as for foreign institutions and agencies, especially of the Western Hemisphere; and the performance of research in insect classification which must provide the basis for definite and complete identifications.

The Problem and its Significance: There are many hundreds of thousands of different kinds of insects. Numerous species within any given group resemble each other so closely as to appear identical but have entirely different habits, in consequence of which they demand different kinds of control or regulation. Exact identifications of insects are therefore fundamental to research, control and regulatory activities involving them. Such identifications can only be made by experts from specimens that have been specially prepared for study and in many insect groups only after extended research.

General Plan: Practically all the work is performed in Washington, D. C. It consists essentially of (a) service activities, involving insect identification and the furnishing of authoritative information on insect classification, nomenclature, habits, distribution and host relationships; and (b) research in insect classification to provide the basis for accurate identifications. Individual specialists are occasionally required to spend brief periods in the field to assist workers on large-scale control or regulation projects in identification problems involved; and visits are made to institutions that are important repositories of insect collections for the purpose of studying special material bearing on research that has been undertaken.

Examples of Progress and Current Program: During the war emphasis is being placed on supplying prompt identifications for insects submitted by military and Public Health officials, for those of potential economic importance intercepted in imported products or taken in the course of special surveys conducted under emergency funds, and for those affecting the production of essential crops or war materials. The samples of such insect material identified in the

fiscal year 1943 were contained in 19,133 shipments and totaled 42,600.

In 1943, individual instruction in the identification of certain mosquitoes and other insects affecting human health was given 74 officers of the Army, Navy, and Public Health Service, assigned to insect control to protect military personnel. Upon request of the War Department available information pertaining to approximately 1,500 species of insects of medical importance occurring in the countries bordering the Mediterranean; in India, in Australia and on the islands of the South and Southwest Pacific, was assembled and organized for effective use in the preparation of directives to field medical units.

Results of research are given in published papers designed to provide the basis for correct identification. In the fiscal year 1943, 39 manuscripts totaling 2,465 pages were completed and submitted for publication. The work on these had been in progress several years, as the service type of activity above-mentioned necessarily has precedence. They cover economic forms in such groups as ants, whiteflies, chiggers, bark beetles, weevils, leaf beetles, plant bugs, thrips, and insect parasites of other insects. In collaboration with the War Department, there was also completed a publication of 152 printed pages entitled "The Anopheline Mosquitoes of the World. A guide to their identification, distribution, habits and relation to malaria." However, owing to reductions in staff and to heavy demands for prompt identification service, nearly all research in insect classification has now had to be suspended for the duration of the war.

(s) Foreign Parasites

Appropriation Act, 1944	\$19,740
Anticipated deficiency for overtime pay required by the War	
Overtime Pay Act of 1943.....	+ 2,490
Total anticipated available, 1944	22,230
Budget estimate, 1945.....	20,000
Decrease ..	- 2,230

PROJECT STATEMENT

Project	1943	1944	1945	Increase or decrease
		(estimated)	(estimated)	
1. Foreign parasite introduction	\$21,849	\$22,230	\$20,000	\$2,230 (1)
Unobligated balance	326	-	-	
Total available	22,175	22,230	20,000	-2,230
Transfer from "Salaries and expenses, entomology and plant quarantine, Agricultural Research Administration, pink bollworm and thurberia weevil control	-1,400	-	-	
Anticipated deficiency for overtime pay	-	-2,490	-	
Total estimate or appro. . .	20,775	19,740	20,000	

DECREASE

- (1) The decrease of \$2,230 in this item for 1945 consists of:
 - (a) A decrease of \$1,731 resulting from a contemplated reduction in the permanent and seasonal employees engaged in the work being carried on in South America in connection with the collection and study of parasites.
 - (b) A decrease of \$499 relating to overtime pay under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	\$1,102	- -	- -
Additional funds for overtime (appropriated; 1943, estimated supplemental; 1944; and included in budget estimate; 1945)	- -	\$2,490	\$1,991
Total cost of overtime (7 months in 1943)	1,102	2,490	1,991

WORK UNDER THIS APPROPRIATION

Objective: To bring about the biological control of insect pests by the importation of their parasites from abroad, thus permitting the more economical production of domestic agricultural crops.

The Problem and its Significance: The great majority of the destructive insect pests attacking agricultural crops in the United States are not native to this country but gained entry from abroad. In the countries of origin they are usually not nearly so injurious, often not requiring control measures, and this is due, in many instances, to the parasites that attack them. These parasites did not accompany the pests when they became established in the United States, and consequently the latter were able to increase to destructive levels. Biological control, when successful, is the most economical method, as the first cost is usually the only cost, and treatment annually, or several times each year, as in chemical and mechanical control, is unnecessary.

General Plan: To maintain a field station in South America for the study and importation of natural enemies of important crop pests, and a domestic receiving station at which the imported material is handled under strict quarantine conditions until released for field colonization. The foreign station, situated at Montevideo, Uruguay,

conducts investigations in all parts of South America, at present principally upon the boll weevil, pink bollworm and stainers of cotton, the sugarcane moth borer, white-fringed beetle, vegetable weevil, bean beetles, etc. Shipments of parasites are also obtained from other countries through cooperative arrangements, and consignments of American parasites are sent to countries that request them. The parasite receiving station at Hoboken, New Jersey receives the imported material under quarantine conditions, eliminates any harmful insects or plant material that may be included, rears the parasites in numbers if required, and then forwards them to domestic field stations for colonization.

The insects for which natural enemies are sought attack a wide variety of important food, forage and fiber crops. The expenses in connection with parasite collection and importation, other than necessary ones of an administrative nature, are provided for from appropriations made for studies on the particular pests. Assistance is furnished and goodwill encouraged among Spanish American countries by exchanging beneficial insects.

Examples of Progress and Current Program: Since the beginning of the work in South America in 1940, marked progress has been made on several problems. The white-fringed beetle survey has yielded much information on its distribution and habits, which will be of value in work upon that pest in the United States. Few parasites, some of them showing considerable promise, have been found upon the cotton boll weevil, cotton stainers, pink bollworm, sugarcane moth borer, vegetable weevil, bean beetle, etc., and many of these have already been shipped to the United States and Puerto Rico.

During 1943, 15 shipments of parasite material were forwarded from South America to the United States, and one to Puerto Rico. Two shipments were received at the Hoboken, New Jersey receiving station from other sources. One domestic parasite was forwarded to a western State. In cooperation with the Office of the Coordinator of Inter-American Affairs, a parasite of the citrus blackfly, Eretmocerus serius, was colonized and established in Sinaloa province, Mexico. Twelve shipments of parasite material were forwarded from the Panama Canal Zone to Mexico for this purpose. During the same period, a parasite of the sugarcane borer was forwarded from Florida and colonies released in Mexico.

(t) Control Investigations

Appropriation Act, 1944	\$66,585
Anticipated deficiency for overtime pay required by the War	
Overtime Pay Act of 1943	<u>\$9,900</u>
Total anticipated available, 1944	<u>76,485</u>
Budget estimate, 1945	<u>76,485</u>

PROJECT STATEMENT

Project	1943	1944	1945	Increase or decrease
		(Estimated)	(Estimated)	
1. Control investigations	\$65,974	\$76,485	\$76,485	--
Unobligated balance	611	--	--	--
Total available	<u>66,585</u>	<u>76,485</u>	<u>76,485</u>	--
Anticipated deficiency for				
overtime pay	--	-9,900	--	
Total estimate or				
appropriation	<u>66,585</u>	<u>66,585</u>	<u>76,485</u>	

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$4,608	--	\$ 66
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	--	\$9,900	9,900
Total cost of overtime (7 months in 1943)...	<u>\$4,608</u>	<u>\$9,900</u>	<u>9,966</u>

WORK UNDER THIS APPROPRIATION

Objective: To find more efficient and economical materials for the control of insect pests; to develop methods and apparatus for more economical application of insecticides; and to develop methods of disinfecting commodities under plant quarantine regulations so that they can move freely and safely in commerce.

The Problem and its Significance: The war has seriously restricted the supply of many insecticides, while at the same time the great increase in agricultural production has increased the demand. Domestically produced insecticides containing critical materials are curtailed, as are those made from imported raw materials due to destruction or capture of the source by enemy powers, or lack of shipping. Added to these problems, the armed forces require great quantities of certain insecticides for the protection of troops from disease-carrying insects. The need for new insecticides, therefore,

from natural or synthetic sources is great.

There is also a continuing necessity for new insecticides to replace those leaving harmful residues when applied to edible portions of plants, and for use against important insect pests for which no satisfactory insecticide is now available.

Toxicological and physiological studies are an important adjunct to the search for new insecticides, in that the method by which insecticides act upon the insect are determined.

More efficient and economical methods for the application of insecticides or insecticidal treatments are needed to keep pace with the development of new insecticides, and to widen the use of those well known.

It is essential, especially in wartimes, that the restriction of movement in commerce of commodities under quarantine regulations be held to an absolute minimum. This may best be accomplished by continued development of fumigation or other methods of treatment to allow commodities to move freely without injury to the commodity or danger of disseminating the pest involved. Such developments are carried on in close cooperation with the other Divisions of the Bureau.

Examples of Progress and Current Program: A field laboratory was established at El Paso, Texas to study fumigation and other insecticidal treatments for various types of plants and produce imported into this country from Mexico, and to further study dosage schedules for the fumigation of empty railway freight cars returning from Mexico to prevent the dissemination of the pink bollworm.

Investigations on treatment methods for the certification of plants and produce under the Japanese beetle quarantine resulted in several new developments; fumigation schedules for nursery stock were added so that treatment can be done down to 38°F.; produce fumigation schedules were expanded to allow treatment of precooled or iced loads of vegetables, and treatment in van or refrigerator trucks, or under gas-proof tarpaulins.

It was shown that cured table stock sweetpotatoes could be fumigated for the sweetpotato weevil without appreciable injury, provided that the post-fumigation temperature of the sweetpotatoes was held at 70° or above for 24 hours following treatment. The work on sweetpotato weevil was terminated and the results of experimental studies made available to the interested States.

Investigations on treatment methods for the certification of plants and produce under the white-fringed beetle quarantine resulted in a series of vacuum fumigation and atmospheric fumigation schedules for nursery plants and produce.

Studies were inaugurated to develop fumigation schedules for larvae of the oriental fruit moth in fruits and to study the effect of such schedules on fresh and stored fruits. These studies were made in cooperation with the California State Department of Agriculture following the

discovery of the fruit moth in certain fruit-growing areas in that State.

In cooperative work with the Division of Insects Affecting Man and Animals, methods of fumigation for delousing soldiers' clothing and equipment were developed at the request of the U. S. Army. Two types of equipment, an individual gas-tight fumigation bag with the fumigant contained in a glass ampule, and a demountable fumigation chamber for use in batteries of three or more for large-scale delousing, were developed and adopted by the Army. Considerable technical advice was furnished the Office of the Surgeon General and the Office of the Quartermaster General in the design and adaptation of the equipment to military use.

Under the same cooperation, a light-weight, portable impregnating vat was designed and built for the impregnation of underwear with an insecticide for louse control.

Rapid advances have been made in the development of equipment for producing heat-generated aerosols for outdoor use.

In insect physiology and toxicology experimental data have been obtained that help to explain the mode of action of an arsenical insecticide on an insect pest. Similar data is being obtained relative to other insecticides. The chigger-itch remedy which was shown by Army tests to be effective also in the treatment of other skin irritations, has been turned over to the Army for further trial.

Final tests of coated arsenical larvicides were made. Early experiments on the improvement of stomach insecticides for use against plant-feeding insect pests have shown promising results. Final tests against bedbugs have shown a new material applied as a kerosene spray to be very effective.

Due to the tremendous use of aerosol "bombs" by the armed forces, much emphasis was placed on this work, and 1,212 aerosol tests were made. These included testing material prepared for army use by manufacturers, testing formulae with reduced amounts of pyrethrum in order to save the dwindling supply, testing the physical properties of aerosols, searching for substitutes and synergists for pyrethrum, and testing possible substitutes for dichloro-difluoromethane (the solvent in the "bomb") which is becoming critically short.

Three-hundred and fifty tests of insect sprays for various formulae containing combinations of the best toxicants were also made to determine their effectiveness against disease-carrying mosquitoes.

The above tests required the establishment of a colony of disease-carrying mosquitoes at the Beltsville laboratory, and the development of biological methods of testing of the aerosols and sprays against uncaged flies and mosquitoes.

A total of 1,469 or more tests were conducted upon vegetable pests to determine the insecticidal value of synthetic organic materials, of which 142 were tested for the first time. One material was found to be extremely toxic to all test insects, and the results, coupled with other

primary tests made simultaneously, have stimulated a Bureau-wide use of the material on practically all of the important insect pests being studied. Forty materials were tested on the Mexican bean beetle, of which two showed promise, one of which was found to be as effective as commercial derris samples. Approximately 300 tests with 73 materials were made upon roaches, none of which proved as effective as pyrethrum or sodium fluoride. Eleven materials were used in approximately 75 tests against fly larvae. One sample proved to be more effective than borax. Thirteen hundred tests were made on houseflies, in which 52 sprays; 97 new materials and 57 materials tested as synergists for pyrethrum were tried. Thirty-nine of these materials and sprays showed enough promise to warrant further testing.

The value of a functioning insecticide testing procedure became apparent when the shortages of standard insecticides became critical. This caused a flood of claims by commercial interests who believed they had toxicants suitable as substitutes. These were immediately and effectively tested, and the relative effectiveness of 30 or more materials was quickly established, which enabled authorities to concentrate on procurement and production of the best material without loss of time.

(u) Insecticide and Fungicide Investigations

Appropriation Act, 1944	\$113,820
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+16,700
Total anticipated available, 1944	130,520
Budget estimate, 1945	<u>130,520</u>

PROJECT STATEMENT

Project	1943	1944 (Estimated)	1945 (Estimated)	Increase or Decrease
1. Chemical investigations on insecticides	\$124,285	\$130,520	\$130,520	- -
Covered into Treasury in ac- cordance with Public Law 674...	200	- -	- -	- -
Unobligated balance	30	- -	- -	- -
Total available	<u>124,515</u>	<u>130,520</u>	<u>130,520</u>	- -
Transferred to "Salaries and expenses, library".....	+2,900	- -	- -	
Anticipated deficiency for overtime pay	- -	- 16,700	- -	
Total estimate or appropriation	<u>127,415</u>	<u>113,820</u>	<u>130,520</u>	

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	\$3,614	- -	\$.125
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	4,500	\$16,700	16,700
Total cost of overtime (7 months in 1943) .	<u>8,114</u>	<u>16,700</u>	<u>16,825</u>

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To improve the chemical materials now employed in controlling insect pests, to develop new and better ones, and to devise improved apparatus and methods for their application, in order to insure the production of food of sufficient quantity and grade to keep up with demands in this time of national emergency, and to safeguard the health of the military personnel exposed to infection by insect carriers of disease.

The Problem and its Significance: Insecticides are absolutely necessary for the control of many kinds of destructive insects in the United States, and normally between 100 and 200 million dollars are spent for insecticidal products in an effort to combat the heavy annual loss occasioned by the ravages of these pests. Many standard insecticides have become scarce for agricultural use because of shutting off of supplies or diversion to military needs. At the same time the need for food production has increased and the labor to produce it has become scarcer. Thus, the search for new insecticides and for more effective ones becomes urgent, and investigational work along these lines needs to be intensified.

General Plan: The work consists of the preparation in the laboratory of new insecticidal materials and of both laboratory and field experiments designed to determine the effectiveness and improve the application thereof. All such work is carried out in close cooperation with the other research divisions of the Bureau. Analyses are made of insecticide materials used in experimental and control work by the several divisions of the Bureau.

Examples of Progress and Current Program: As much effort as possible was devoted to those lines of work most directly connected with the war effort.

The investigation of aerosols was vigorously prosecuted. Constant assistance was given to companies interested in packaging the freon-pyrethrum solution, with the result that there are now four manufacturing firms producing satisfactory "bombs" of which about 5 million have been manufactured. The physical properties of the solution, such as liquid and vapor densities and vapor pressure, were measured, and it was thereby shown that the concentrating effect which occurs during discharge of the solution is not serious. When it appeared that the supply of freon-12 might be insufficient for the needs of the aerosol programs of the Army and Navy, substitutes for it were investigated. Those found to have some promise comprised methyl chloride, propane, butane and dimethyl ether, and cooperative studies were begun with the U. S. Bureau of Mines to determine just how much of each of the 3 latter ones could be used without incurring danger from fire. Many variations of formulae were prepared for testing against insects, and because the most promising ones included DDT, its solubility in many organic liquids was studied as a basis for choosing the best auxiliary solvent needed because of the low solubility in freon-12 itself.

Under this appropriation, intensive and detailed assistance was given to the Bureau's laboratory at Orlando, Florida in the efforts to develop lousicides, mosquito larvicides, and insect repellents. Hundreds of organic compounds were furnished for test, and when a satisfactory lousicide including dinitroanisole was decided upon, methods of analysis were developed for a certain constituent in the powder and for the impurity which it frequently contains, which are skin irritants and hence must be rigidly excluded. When it was found that the commercially prepared product, designated DDT, possessed marked value as a lousicide and mosquito larvicide, this chemical was thoroughly investigated. Its manner of preparation was studied, and other similar compounds prepared.

When the quantity that could be imported from the Swiss manufacturers was found to be entirely too little for the Army's requirements, steps were taken to assist an American manufacturer in getting started on its production; now he is producing weekly several tons of a very good grade. This chemical was also adapted to mosquito larvicide control, and when it proved to be particularly suited to killing flies, it was also adapted to use in the aerosol.

All of this work brought with it repeated demands from the Army for specifications covering the finished louse powders, aerosols, etc., and the various constituents of which they were to be compounded. Many such specifications were drawn up and submitted, and several of them are now the basis for the large purchases by the armed forces.

Attention was also given to increasing the supply of, or finding substitutes for, various other insecticides. As a means of augmenting the possibly short supply of arsenic for insecticidal use, a study was made of the possibility of using calcium arsenite of a crude form of which about 20,000 tons is available at Trail, British Columbia. Difficulty is being experienced in efforts to develop methods of converting it to calcium arsenate. Steps were also taken to investigate the possible usefulness of ferric arsenate, of which a large deposit, in the form of the mineral scorodite, is available in Utah. Because of the relative plentifulness of fluorine, efforts were made to secure increased production of potassium fluosilicate, which because it is less soluble than sodium fluosilicate should be less injurious to vegetation than that insecticide, and which would certainly be less objectionable from the spray residue standpoint than barium fluosilicate because of the absence of the poisonous element barium.

An active part was taken in the search for additional sources of rotenone. All samples of barbasco imported from South and Central America by the Office of Economic Warfare were analyzed for their content of rotenone and other extractives. In addition, careful investigation was made of three other plants reported or thought to contain rotenone. These tests proved to be negative.

Since pyrethrum continues to be one of the most important insecticides because of its use in the Army's aerosol program, it was given additional attention, and a revised factor adopted which now brings our results into practical accord with the method used in the trade, and paves the way for the future adoption of the official method by all parties concerned with pyrethrum. The need for specifications covering sesame oil when used to intensify the action of pyrethrum in the aerosol led to the development of a satisfactory method of determining its sesamin content, on which the intensifying action depends.

(v) Transit Inspection

Appropriation Act, 1944	\$38,940
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 6,960
Total anticipated available, 1944	45,900
Budget estimate, 1945	<u>45,900</u>

PROJECT STATEMENT

Project	1943	1944 (Estimated)	1945 (Estimated)	Increase or decrease
1. Transit inspection	\$43,285	\$45,900	\$45,900	--
Covered into Treasury in accordance with Public Law 674	250	--	--	--
Unobligated balance	800	--	--	--
Total available	<u>44,335</u>	<u>45,900</u>	<u>45,900</u>	--
Anticipated deficiency for overtime pay	--	-6,960	- 1,000	
Total estimate or appropriation	<u>44,335</u>	<u>38,940</u>	<u>45,900</u>	

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	*\$1,400	--	--
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	3,100	\$6,960	\$6,960
Total cost of overtime (7 months in 1943) ..	<u>4,500</u>	<u>6,960</u>	<u>6,960</u>

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To assist in the prevention of spread of serious agricultural pests not heretofore widely spread throughout the United States by enforcing federal domestic plant quarantines which require compliance by shippers and common carriers with stipulated sanitation and inspection measures necessary to prevent the spread of such pests from the areas to which they are at present confined.

The Problem and its Significance: Agricultural pests not heretofore widely distributed throughout the United States may be spread long distances by numerous articles moving in interstate commerce. In order that such materials may be safely shipped to uninfested or uninfected areas it is necessary that they be grown, produced, treated or handled prior to shipment in such a manner that the pests will not be carried. Plant quarantines have been promulgated to require such sanitary safeguards as are necessary to prevent the distribution of pests and compliance with necessary safeguards is determined by transit inspectors who are stationed at strategically located transportation centers through which a large majority of interstate shipments by common carrier is systematically routed. These inspectors examine shipments to determine conformance with sanitary safeguards and intercept shipments involving pest risk when moving in violation of federal quarantines. Transit inspectors are assisted in their work by the cooperation of employees of the common carriers and State pest control officials.

General Plan: Including State and Federal Cooperation: During the fiscal year 1943, inspection was conducted at 16 transportation centers, nine of which were operated on a seasonal basis. The inspection force consisted of 21 inspectors paid wholly or in part from transit inspection funds and 13 inspectors assigned to assist in the work by cooperating agencies. Very considerable assistance is given inspectors by the cooperation of several thousand mail, express, and freight employees who watch for shipments of restricted materials, segregate and hold them for examination by the inspectors. State cooperative contributions for the fiscal year 1944 will amount to approximately \$18,500.

Assignments are frequently changed, new stations opened, or old ones discontinued to meet the inspection requirements occasioned by changes in quarantines or in regulated areas.

Examples of Progress and Current Program: During 1920, the first year transit inspection was conducted, 12 out of each 1,000 shipments inspected were found to be moving in violation of quarantine regulations; in 1943 this ratio had been reduced to less than .6 per 1,000 shipments. This illustrates the effectiveness of transit inspection in educating the public to quarantine requirements, a phase of the work which is considered of major importance. Out of a total of nearly 2,290,000 shipments inspected during the fiscal year 1943, 1,322 violations of 7 of the 9 federal domestic plant quarantines and regulations pertaining to the movement of plants into and out of the District of Columbia were intercepted. These shipments were destined to 44 different States, the District of Columbia and Canada. In addition 1,020 shipments were observed to be moving in apparent violation of State pest control and nursery certification requirements and the officials of the States concerned were notified.

During recent years transit inspectors have intercepted a number of shipments in transit infested with such injurious pests as gypsy moth and Japanese beetle. If such shipments had been allowed to proceed to their destinations, new centers of infestation might have become established.

(w) Foreign Plant Quarantines

Appropriation Act, 1944	\$682,900
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 112,000
Total anticipated available, 1944	794,900
Budget estimate, 1945	797,700
Increase	+ 2,800

PROJECT STATEMENT

Project	1943	1944	1945	Increase or decrease
		(estimated)	(estimated)	
1. Import and permit ser- vice for issuance of per- mits for the importa- tion of plants and plant products to comply with plant quarantines	\$32,047	\$37,300	\$37,400	+ \$100
2. Inspection at ports of: entry of plants and plant products regulated by plant quarantines	741,338	757,600	760,300	+2,700
Covered into Treasury in accordance with Public Law 574	707	- -	- -	- -
Unobligated balance	8,258	- -	- -	- -
Total available	782,350	794,900	797,700	+ 2,800 (1)
Anticipated deficiency for overtime pay	- -	-112,000	- -	
Total estimate or appropriation	782,350	682,900	797,700	

INCREASE

(1) The increase of \$2,800 in this item for 1945 is for overtime pay required under the War Overtime Pay Act of 1943.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	*\$2,694	- -	- -
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	62,800	\$112,000	\$114,800
Total cost of overtime (7 months in 1943)	65,494	112,000	114,800

*Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To protect agriculture by administering plant quarantines and regulatory orders, issued under the Insect Pest Act of 1905, the Plant Quarantine Act of 1912, as amended, and the Mexican Border Act of 1942, to prevent the entry of insect pests and plant diseases from foreign countries, Puerto Rico and Hawaii and control and safeguard the entry of plants, plant products and other articles which may carry such pests.

The Problem and its Significance: The estimated average annual loss from introduced foreign insect pests of plants and plant products is \$1,500,000,000. This figure does not include huge annual losses from introduced fungous, bacterial, and virus diseases of plants. It is vital that every possible effort be made to prevent the introduction and establishment of additional foreign plant pests which could impede the war effort through reduction of food supplies and essential crops.

World commerce has been completely changed by the war, and current conditions impose new problems of foreign plant quarantine enforcement through the substitution, for normal commercial shipping, of abnormal wartime shipping and the movement of the ships and aircraft, troops, and supplies, of the armed forces. The exigencies of the latter movements create a set of problems peculiar to the situation which necessitate intensive supervision of the personnel and work, and constant adjustment of emphasis to meet the changes occurring from day to day.

Receipts: During the fiscal year 1943 receipts of \$49,600 resulted from the fee of \$4.00 a car charged for fumigating railroad cars entering this country from Mexico. This fumigation is required as a safeguard against the introduction of insects attacking cotton. Estimated receipts from this source in 1944 are \$60,000.

General Plan: Under the Plant Quarantine Act most kinds of plant propagating materials, fruits, vegetables, cotton lint and related products, cereals, etc., may be imported only under permit, subject to inspection, and in some instances supervised disinfection, sterilization, etc., at the ports of entry. In Hawaii and Puerto Rico the movement of certain plants and plant products to the mainland is supervised, and certain products are treated under supervision for the prevention of the movement of injurious pests with these products. The work is organized under two general headings (a) Import and Permit, and (b) Port Inspection, and is conducted at a cost of less than 1/2000 of the estimated annual loss from introduced insect pests, which does not include loss from introduced plant diseases.

During the fiscal year 1944, cooperation from States and territories amounted to \$178,300, the major contribution being from California and Florida.

Examples of Progress and Current Program:

Import and permit: In 1943 it was possible to intensify the continuing study of procedures used in issuing, as required by Section 1 of the Plant Quarantine Act of 1912, as amended, permits for the importation of all plants and plant products regulated by plant quarantines. In considering changes that may be made in procedure, special attention is given to simplification for the benefit of the importing public and to afford a means of expediting plant quarantine clearance of importations upon arrival. While there is reduction in numbers of permits issued in 1943 as compared with previous years, this does not involve a corresponding change in the total work load, although some of the work may be shifted to the various ports of entry and merged with the work performed under the project "Inspection at Ports of Entry."

Associated with the actual issuance of permits there is a considerable amount of necessary correspondence with the importing public and the inspectors located in the ports of entry concerned with the entry status of proposed importations and the plant quarantine entry requirements to be met. The abnormal shipping caused by the trends of the war, particularly by the activity of enemy submarines, has been responsible for an additional load of this correspondence. The necessity for arranging, on short notice, emergency conditions of entry for cargoes of ships in distress, etc., and embracing essential sanitary safeguards involving unusual conditions of handling, treatment, and routing has increased the work load to more than offset any saving in reduced operations in issuance of permits.

Port inspection: The following discussions of the activities under this financial project are grouped under functional operations.

Airplane inspection: The inspection of airplanes arriving from foreign countries increased 51 percent in 1943 over 1942. The 13,093 airplanes inspected were the greatest number for any year in the history of plant quarantine enforcement. These airplanes arrived from all parts of the world and at many newly established airports. It was necessary to assign additional inspectors to this activity at the expense of thorough work at maritime ports. In some instances it became necessary to arrange for plant-quarantine coverage of these arrivals on a 24-hour-per day basis. The Army and Navy recognize the vital importance of protecting the country against plant pests that may gain entry by air and have increased the cooperation in the plant-quarantine enforcement program. The importance of this work is evidenced by the interception of potential plant-pest carrying material in one of each four airplanes inspected. In many cases this material was infested with various known pests. Oranges from Africa contained larvae of a species of fruitfly closely related to the Mediterranean fruitfly. Oranges from South America were infected with an important disease which disfigures fruits. Foliage bearing living stages of the destructive citrus blackfly, which is known to attack a wide variety of economic plants, has been intercepted on many occasions.

Mail from military and naval personnel: The examination of mail from members of the armed forces stationed abroad presents an entirely new problem in plant-quarantine enforcement. This class of mail is, for postal and customs purposes, handled differently from regular mail. It may arrive at any seaport or airfield. At first much of it was delivered without there being an opportunity to examine it for the presence of plant-pest carrying materials. Through the cooperation of the Army and Navy and the Post Office and Treasury Departments, procedures have been worked out for the domestic handling of this mail so that packages are brought to the attention of plant-quarantine inspectors for plant-quarantine examination. Improvements in handling are frequent, but there is still need for additional changes to give protection from plant pests. The work load has increased even out of proportion to the increase in number of parcels, because of the postal-customs procedures for handling this mail. Studies now under way may demonstrate the necessity for assigning trained inspectors to interior ports where this class of mail is handled in volume in order to provide the maximum practical protection against pest entry by this means. Recent interceptions include the finding of numbers of living pink bollworm larvae in seed cotton used as packing for souvenirs destined to the South.

In some localities the inspection of service mail is superimposed on and made a part of the regular operations of foreign mail inspection. At these established offices the volume of packages inspected in 1943 was only 10 percent less than in 1942, even though war conditions have greatly curtailed normal mail movement. In the course of such inspections at one port on the West Coast, a wheat-attacking earwig from Australia was intercepted.

Enforcement of the Mexican Border Act: The regulation, inspection and, when necessary, fumigation of freight cars crossing into the United States from Mexico are provided for by legislation commonly referred to as the Mexican Border Act. The 69,184 freight cars inspected in 1943 as a condition of entry into the United States represent a 26 percent increase over 1942, and the 12,142 cars requiring fumigation were an increase of 52 percent over the previous year. Reports for the first three months of the fiscal year 1944 show an increase in this activity of over 56 percent as compared with the first three months of last year. Congestion in railroad freight yards on both sides of the Border at the crossings from Mexico resulted in a request from the United States Railway Mission to Mexico for fumigation service outside of scheduled hours. This request was granted promptly, even though it materially increased the already heavy work load. Currently, the volume of traffic through Brownsville, Texas is so great that the fumigation facilities at that port are severely taxed.

Ship inspection: The arrival of ships in convoys and the wartime measures employed by other agencies for national security has introduced new and complicated problems of plant-quarantine protection. A new problem directly associated with wartime transportation arose during the past year when ships returning to this country were found to be using dry ballast consisting in part of surface soil which contained various pests. Among the more important of the insects found in such soil was a species of beetle belonging to a group which contains many economically important pests. The disposal of this type of ballast under adequate sanitary safeguards has involved much time and effort. The fact that ships now arrive from all corners of the world with strange cargoes and manned by officers and crews with little or no experience in meeting plant-quarantine regulations accentuates the risk of entry of many little known exotic pests.

Absence of knowledge of pests of a region complicates inspection. There is always danger of introducing pests, such as the Japanese beetle, which are of limited importance in their native habitats, but if established here might become major pests of vital food crops and essential raw materials. An example is the recent interception of a bruchid which is a major pest of faba beans in Egypt and is a most destructive seed-weevil because of its ability to reinfest dried beans, etc. It is not yet established in this country.

Cargo inspection: The exigencies of war have changed the nature and volume of importations of plant and plant products from the peacetime pattern. Experience has shown that we can expect a continuance of diversity of problems in plant-quarantine enforcement and that those of many ports may change in short order in volume and present new problems in plant-quarantine enforcement. For example, a torpedoed ship buoyed by its cargo of cotton lint, not normally admitted at ports in the cotton-growing areas of the South, safely made harbor at a southern port where its cargo was discharged. This handling of the cargo had to be safeguarded to prevent the possible entry of the pink bollworm. The lot had to be reconditioned under quarantine supervision (requiring 502 man-hours of inspection time), and safeguards had to be imposed to prevent pest dispersal to the cotton areas nearby, until the cargo was reloaded and the repaired ship was ready to sail. There have been marked variations in cargo volumes at some of the ports and it has been necessary to shift personnel to help in handling the vastly increased volumes of traffic at other ports.

(X) Certification of Exports

Appropriation Act, 1944	\$29,180
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+ 5,300
Total anticipated available, 1944	<u>34,480</u>
Budget estimate, 1945	<u>34,480</u>

PROJECT STATEMENT

Project	: 1943 :	1944 : (estimated):	1945 : (estimated):	: Increase or decrease
1. Certification of ex- ports	\$32,757:	\$34,480	\$34,480	- -
Unobligated balance	53:	- -	- -	- -
Total available	<u>32,810:</u>	<u>34,480</u>	<u>34,480</u>	<u>- -</u>
Anticipated deficiency for: overtime pay	- - :	-5,300	- -	
Total estimate or appropriation	<u>32,810:</u>	<u>29,180</u>	<u>34,480</u>	

Statement of Overtime Costs

	: 1943	: Est. 1944:	Est. 1945
Overtime absorbed	- -	- -	- -
Additional funds for overtime (appropriated: 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	*\$2,085	\$5,300	\$5,300
Total cost of overtime (7 mos. in 1943):	<u>\$2,085</u>	<u>\$5,300</u>	<u>\$5,300</u>

* Actual appropriation was \$2,100.

WORK UNDER THIS APPROPRIATION

Objective: To inspect and certify shipments of plants and plant products offered for export to meet the sanitary requirements with respect to insect pests and plant diseases of the foreign countries of destination, thus enabling exporters to comply with conditions of importation into such countries without which the importations would be prohibited.

The Problem and its Significance: Many foreign countries have imposed additional requirements governing importations of plants and plant products and have increased their enforcement of existing sanitary requirements. The growers and exporters of this country have faced loss of markets without strict inspection and adequate certification of their exports of plant

materials. War has intensified this situation. Under the provisions which have been made annually in the Appropriation Act of the Department of Agriculture commencing in 1927, this activity has enabled the growers and exporters to meet these requirements if the condition of their shipments warrant the required certification. With the closing of markets in war-ridden Europe, exporters are seeking to maintain contact with foreign outlets for products normally surplus and this service affords an even greater aid to them in shipping products which will satisfy the entry restrictions of the countries in which the new markets are located.

Exportations are now also made to Central and South American countries in line with the inter-American program for meeting the agricultural requirements of the United Nations.

Receipts: Receipts in the amount of \$1,564 were collected during the fiscal year 1943. The \$1.00 fee charged for each certificate issued was not collected from agencies of the federal government. It is estimated receipts from this source in 1944 will amount to \$1,500.

General Plan: This work is performed largely in conjunction with port inspection activities under the appropriation for Foreign Plant Quarantines, since export certificates may be issued at any of the various ports where plant quarantine inspectors are stationed. The work is so organized that State-federal inspection personnel operating under the Apple and Pear Export Act, enforced by the Food Distribution Administration, assist in the inspection at shipping point of apples and pears in order that they may also meet the sanitary requirements of the countries of destination. Such sanitary shipping-point inspection is supervised by designated employees of this Bureau during the shipping season.

Current Activities: In pre-war years apples, pears, and certain other similar commodities were shipped in large volume to European markets. Now the direction of the certified exports is almost limited to the countries in this hemisphere and propagating materials, particularly seeds, predominate. Fewer certificates are issued currently than was formerly the case; however, the work load has not been correspondingly reduced. The time required to inspect a single shipment of miscellaneous seeds for Brazil is several times greater than required to inspect and certify a carload of apples. The seed shipments are usually made up of numerous packages and sometimes the requirements of certification demanded by the foreign country differ with the type of seed. Potatoes exported in volume from a southern port to Cuba likewise required unusual time for inspection because of the Cuban sanitary requirements.

(y) Special Research Fund, Department of Agriculture
(Allotment to Bureau of Entomology and Plant Quarantine)

This budget schedule covers obligations under an allotment for special entomological research projects dealing with the subject of bee products in relation to health.

(z) White Pine Blister Rust Control
(Bureau of Entomology and Plant Quarantine)

This budget schedule covers obligations under an appropriation (also involving the Forest Service and the Department of the Interior) for leadership, coordination, and technical direction of white pine blister rust control; blister rust quarantine enforcement, and cooperative blister rust control on State and privately owned lands.

(aa) Emergency Rubber Project, Department of Agriculture
(Allotment to Bureau of Entomology and Plant Quarantine)

This budget schedule covers obligations for entomological research and advice on guayule.

(bb) Emergency Fund for the President, National Defense
(Transfer to Bureau of Entomology and Plant Quarantine)

This budget schedule covers obligations under a special transfer in connection with the prevention of insect pest infestations and plant diseases.

(cc) Working Funds (Bureau of Entomology and Plant Quarantine)

This budget schedule covers obligations under advances, pursuant to Section 601 of the Economy Act of June 30, 1932, for services performed for various agencies as shown in the attached statement of supplemental funds.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS

Item	Obligations, 1943	Estimated obligations, 1944	Estimated obligations, 1945
<u>Special Research Fund: Special</u>			
entomological research	\$14,972	\$15,000	\$15,000
<u>Allotment: Regular Item for White</u>			
<u>Pine Blister Rust Control:</u>			
Leadership, coordination, and			
technical direction of white			
pine blister rust control ...	475,946	525,815	526,315
Blister rust quarantine			
enforcement	9,743	11,970	11,970
Cooperative blister rust			
control on State and privately:			
owned lands	283,790	302,168	302,658
Total, White pine blister			
rust control	769,479	839,953	840,953
<u>Emergency rubber project: Entomo-</u>			
logical research and advice on			
guayule rubber	8,913	26,420	26,000
<u>Emergency fund for the President,</u>			
<u>National defense: Emergency</u>			
insect pest prevention	5,917	241,083	- -
<u>Working Funds (Bureau of Entomology</u>			
<u>and Plant Quarantine) Advances</u>			
<u>from:</u>			
Office of Scientific Research			
and Development:			
Investigations of larvicides			
for control of breeding			
places of Anopheles mos-			
quitoes for protection of			
armed forces from malarial			
infections	32,722	51,705	- -
Investigations of repellents			
for protection of man and			
animals from annoying and			
disease-bearing insects ...	56,677	73,519	- -
Investigation of methods of			
protecting armed forces of			
United States from infesta-			
tion by human lice to pre-			
vent outbreaks of serious			
diseases	58,016	70,608	- -
Total, Office of Scientific			
Research and Development ..	147,415	195,832	- -

Item	Obligations, 1943	Estimated obligations, 1944	Estimated obligations, 1945
<u>Foreign Economic Administration:</u>			
Assistance to Mexico in biological warfare	604	761	- -
<u>War Department:</u> For control of the dog fly along Florida Gulf Coast in vicinity of air training stations	73,882	125,718	- -
<u>Commodity Credit Corporation:</u> Investigations of methods of properly caring for grain in storage	14,266	17,375	- -
Total, Working Funds	236,167	339,686	- -
Total, obligations under supplemental funds	1,035,448	1,462,142	881,953

(dd) Control of Incipient and Emergency Outbreaks of
Insect Pests and Plant Diseases

Budget estimate, 1945 \$2,700,000 (a)

(a) In 1944 there is available for obligation a balance of \$3,311,122 of the funds appropriated in 1943 by Public Law 11, approved March 18, 1943.

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):
1. Grasshopper and Mormon cricket control	\$636,731:	\$1,461,900:	
2. Army worm control	- - :	32,000:	
3. White fringed beetle control	673,246:	823,555:	
4. Pear psylla control	394,136:	500,000:	
5. Chinch bug control	36,464:	48,400:	
6. Mole cricket control	34,500:	50,000:	
7. Hall scale eradication	35,948:	46,000:	
8. Parlatoria chinensis survey	16,270:	23,000:	
9. General surveys	19,295:	155,705:	
Reserve for future allotment	- - :	170,562:	
Unobligated balance	18,656:	- - :	
Total available	1,865,246:	3,311,122:	2,700,000 (1)
Prior year appropriation obligated in 1943	-1,454,368:	- - :	
1943 appropriation obligated in 1944	+3,311,122:	-3,311,122:	
Total estimate or appropriation ...	3,722,000:	- - :	2,700,000

(1) Because of the emergency nature of the work and seasonal factors, it is impossible to forecast at the present time the amounts required for specific projects during the fiscal year 1945.

Explanation of Item: This is a new item in the annual Agricultural Appropriation Bill. However, the work proposed to be performed thereunder has been conducted since the fiscal year 1937 with appropriations made in various deficiency acts, under basic legislation approved May 9, 1938, (U.S.C. 148-148E) authorizing and directing the Department to cooperate with States in carrying out activities to control and eradicate incipient and emergency infestations of pests destructive to agriculture. Hence, the activity is not a new one. The supplemental appropriations have been based on crop season requirements.

The proposed inclusion of this item in the Agricultural Appropriation Act for 1945 is in accordance with the suggestion made by the House Committee on Appropriations when that Committee reported the item which provided for the control of incipient and emergency outbreaks of insect pests and plant diseases for the crop season 1943 in the "First Deficiency Appropriation Act, 1943". Their report (House Report 170, 78th Congress, First Session) includes (pages 12-13) the following statement:

"The recommendation of \$3,500,000 for control of incipient insect pests and diseases is a reduction of \$444,000 under a Budget estimate of \$3,944,000. This appropriation has customarily been carried in the first deficiency bill each year due to the fact that planning and operation can better be carried on a calendar rather than a fiscal year basis. The committee feels that in the future all, or such part of the yearly amount as can without injury to the planning and effectiveness of the work, should be transferred to the Budget estimates for the regular annual bill."

The purpose of this appropriation, as has been the case in the past, is to provide the Department with funds to cooperate with the States in dealing promptly and adequately with incipient or emergency outbreaks of insect pests and plant diseases. Since outbreaks of this sort ordinarily occur on a crop year rather than a fiscal year basis, it is not possible at present to forecast with accuracy the amounts which may be required on various projects, or, in fact, the occurrence of insects and plant diseases which may reach proportions requiring emergency attention during the fiscal year 1945. It seems reasonably certain that control work will continue to be necessary against such pests as the grasshopper, chinch bug, Mormon cricket, white-fringed beetle, pear psylla, mole cricket, and certain other insects against which work has been conducted for several years past. There may also be new pests encountered. The current estimate provides funds on the basis of the approximate average annual allotments for the past eight years. It is the hope that this annual average amount will prove adequate, but if as the season develops it becomes apparent that it is not, it will be necessary to submit a supplemental estimate.

A nucleus organization already is in existence for planning control work and securing the personnel, equipment and supplies required to combat outbreaks of grasshoppers, Mormon crickets, chinch bugs, white-fringed beetles, and pear psylla. The detailed estimates for this item provide for the continuance of this organization which includes the personal services needed both at headquarters and field locations to administer and supervise the work. The detailed Budget schedules do not, however, specifically reflect the seasonal and intermittent employees needed for actual field control operations nor do they reflect in detail the purchase and transportation of control materials. Any detailed estimate made at this time for such purposes as these might be widely inaccurate and it was felt advisable to limit the detailed estimate to the type of expenditures outlined above and to leave an unallotted balance from which could be made the necessary employments and purchases to meet the conditions arising in field operations.

It is reasonable to anticipate that operations against grasshoppers will continue in 1945 to a greater or lesser extent in most of the States west of the Mississippi River, work against the pear psylla in the States of Washington and Idaho and contiguous portions of British Columbia, chinch bug control in locations where it may occur, principally in the Corn Belt States, and Mormon cricket operations in Montana, Wyoming, Colorado, Utah, Nevada, and possibly other western States. The white-fringed beetle occurs in the southeastern States and in North Carolina, and continued operations there are planned.

CHANGES IN LANGUAGE

For this item it is proposed to use the following language, which with the exceptions indicated, is identical with that used in the First Deficiency Appropriation Act, 1943 (Act of March 18, 1943, Public Law 11):

Control of incipient and emergency outbreaks of insect pests and plant diseases: To enable the Secretary of Agriculture to carry out the provisions of and for expenditures authorized by the joint resolution approved May 9, 1938 (7 U.S.C. 148-148e), including surveys and control operations in Canada in cooperation with the Canadian Government or local Canadian authorities, and the employment of Canadian citizens, [fiscal year 1943, \$3,722,000, to remain available until June 30, 1944] \$2,700,000.

The clause bracketed out is no longer necessary as the inclusion of this item in the Agriculture Appropriation Act will place it on the usual fiscal year basis and the funds will be available for the fiscal year 1945.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	: \$105,207	: \$311,793	: \$149,828
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	: - -	: - -	: - -
Total cost of overtime (7 months in 1943)	: 105,207	: 311,793	: 149,828

WORK UNDER THIS APPROPRIATION

Up to the present time, work under this appropriation has been conducted on the basis of a crop season rather than a fiscal year, and appropriations have been made in the same way. It is therefore not practicable to report on the work done under this item on the basis of a fiscal year. The following briefly summarizes the activities which have been conducted

with funds made available under the authorization for the control of incipient and emergency outbreaks of insect pests and plant diseases.

Public Resolution No. 20 (75th Congress) authorized an appropriation of \$2,000,000 for the control of incipient and emergency outbreaks of insect pests and plant diseases, including grasshoppers, Mormon crickets, and chinch bugs. It also authorized that the funds appropriated should remain available until expended and the appropriation of such additional sums as might be necessary to replenish the fund to its original amount at the beginning of each fiscal year.

Public Resolution No. 91 (75th Congress) amended this legislation by removing the limitation of \$2,000,000 and authorizing the appropriation of such amounts as might be necessary. Eleven appropriations have been made under these authorizations, as follows: Two of \$1,000,000 each, the first by Public Resolution No. 26, approved April 27, 1937, and the second by Public Resolution No. 55, approved July 17, 1937; one of \$2,000,000 by Public Resolution No. 81, approved March 2, 1938; one of \$700,000 by the Second Deficiency Act, fiscal year 1938; one of \$3,000,000 by the First Deficiency Act, fiscal year 1939; one of \$1,750,000 by Public Resolution No. 22, approved June 13, 1939; one of \$2,500,000 by the First Deficiency Act, fiscal year 1940; one of \$800,000 by the Second Deficiency Act for the same year; one of \$2,225,000 by the First Deficiency Appropriation Act, 1941; one of \$1,750,000 by the Sixth Supplemental National Defense Appropriation Act, 1942; and one of \$3,722,000 by the First Deficiency Appropriation Act, 1943. Of these appropriations all but the last one have expired; this remains available until June 30, 1944. It may, however, be necessary to request a supplemental appropriation to provide for work from the beginning of the 1944 field season until July 1, 1944, when the regular 1945 appropriation presumably will become available.

A majority of the funds provided by these several appropriations in the past have been used to enable the Department to cooperate with States in combating widespread outbreaks of grasshoppers. The funds have, however, made it possible to take active measures on a large scale against the white-fringed beetle, the Mormon cricket, and the pear psylla. Also from year to year, work has been done against other pests, which, although less widespread, are nevertheless serious threats to important agricultural commodities. In this latter group, control activities were carried on during the 1943 field season against the chinch bug, the mole cricket, the scale insect Parlatoria Chinensis and the Hall scale.

PASSENGER-CARRYING VEHICLES

No estimate is submitted for the purchase of passenger-carrying vehicles for the Bureau of Entomology and Plant Quarantine for the fiscal year 1945. While the passenger cars already in use are, of course, gradually wearing out, it is felt that by extremely careful and economical use of them it will be possible to defer the necessity for replacements until the fiscal year 1946.

It is planned to continue 274 old vehicles in operation during 1945.

AGRICULTURAL RESEARCH ADMINISTRATION

Bureau of Agricultural and Industrial Chemistry

(a) Salaries and Expenses - Preamble

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of the appropriation preamble as follows (new language underscored, deleted matter enclosed with brackets):

Bureau of Agricultural and Industrial Chemistry [and Engineering]

Salaries and Expenses

For investigations, experiments, and demonstrations hereinafter authorized, independently or in cooperation with other branches of the Department, other departments or agencies of the Federal Government, States, State agricultural experiment stations, universities, and other State agencies and institutions, counties, municipalities, business, farm, or other organizations and corporations, individuals, associations, and scientific societies, including the employment of necessary persons and means in the city of Washington and elsewhere; and for erection, alteration, and repair of buildings outside the District of Columbia at a total cost not to exceed \$15,000 (which limitation shall not apply to the Regional Research Laboratories authorized by section 202(a) of the Agricultural Adjustment Act of 1938), as follows:

The first change would make the designation of the Bureau conform to the redesignation effected by Agricultural Research Administrator's Memorandum No. 5, approved by the Secretary on February 13, 1943, pursuant to Executive Order 9069, dated February 23, 1942.

The other change inserts, parenthetically, the language "which limitation shall not apply to the Regional Research Laboratories authorized by section 202(a) of the Agricultural Adjustment Act of 1938" for the purpose of qualifying the existing authority and limitation "for erection, alteration, and repair of buildings outside the District of Columbia at a total cost not to exceed \$15,000" so as to restrict its applicability to those subappropriation items of the Bureau which contain no other authority for such purposes. The enabling act establishing the Regional Research Laboratories provides the necessary authority for the construction and maintenance of buildings in connection with the four laboratories. Since the Regional Research Laboratories are carried in the 1945 estimates as a subappropriation item within the Bureau's mainhead appropriation, and thus in 1945 would be subject to the provisions of the appropriation preamble, this change is necessary to avoid conflict with the basic legislative authority.

All projects covering "Acquisition of site and construction and equipment of Regional Research Laboratory buildings" have been closed, since all sites have been acquired, and all initial construction and equipment installations contemplated by the projects to provide basic facilities for operation of the Laboratories have been completed. However, certain construction items, as well as special equipment items, necessarily are required from time to time as an integral part of the research program facilities, particularly in connection with pilot plant operations. Such construction and equipment items would not be a part of the original project which provided for initial construction and standard equipment installation as related to the laboratory building and, therefore, will be chargeable to the various commodity projects requiring such facilities.

(b) General Administrative Expenses

Appropriation Act, 1944	a/ \$73,330
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+8,920
Total anticipated available, 1944	82,250
Budget estimate, 1945	<u>82,250</u>

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. General administration	:	:	:	:
and business service	\$69,206:	\$82,250:	\$82,250:	--
Unobligated balance	4,124:	--:	--:	--
Total available	<u>73,330:</u>	<u>82,250:</u>	<u>82,250:</u>	<u>--</u>
Transferred to "Salaries and expenses; Office of Admin- istrator, Agricultural Re- search Administration" ...	+4,000:	--:	--:	--
Anticipated deficiency for overtime pay	--:	-8,920:	--:	--
Total estimate or appropriation	<u>77,330:</u>	<u>73,330:</u>	<u>82,250:</u>	

a/ Excludes \$28,714 transferred pursuant to Executive Order 9069 of February 23, 1942, to other appropriations, as follows: "Salaries and expenses, Bureau of Human Nutrition and Home Economics," \$2,435; "Salaries and expenses, Bureau of Plant Industry, Soils, and Agricultural Engineering," general administrative expenses, \$26,279.

Statement of Overtime Costs

	1943	Est. 1944	Est. 1945
Overtime absorbed	5,950:	1,330:	1,330
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944: and in- cluded in budget estimate, 1945)	--:	8,920:	8,920
Total cost of overtime (7 months in 1943)	<u>5,950:</u>	<u>10,250:</u>	<u>10,250</u>

WORK UNDER THIS APPROPRIATION

This appropriation provides for administrative supervision and direction of the work of the Bureau, to carry on the business activities necessary for the proper functioning of the organization as a whole, including personnel, budget, bookkeeping, auditing, purchase and property, editorial and information, files and miscellaneous services and records.

(c) Agricultural Chemical Investigations

Appropriation Act, 1944 a/ \$304,518

Proposed transfer in 1945 estimates:

To "Salaries and expenses, Bureau of Plant Industry, Soils, and Agricultural Engineering," cereal crops and diseases (for evaluating cereal varieties for food and other uses)	-26,201
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+26,558
Total anticipated available, 1944	304,875
Budget estimate, 1945	294,875
Decrease	<u>-10,000</u>

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):	Increase or decrease
1. Fruits, vegetables and other agricultural products of the South	\$43,511:	\$51,470:	\$51,470:	--
2. Sugar and sirups investigations	64,754:	71,785:	71,785:	--
3. Investigations on pharmacology of agricultural products	23,655:	26,760:	26,760:	--
4. Investigations on enzymes and phytochemistry	29,241:	33,360:	33,360:	--
5. Fruits, vegetables and other agricultural products of the West	39,866:	43,080:	43,080:	--
6. Fundamental investigations in micro-biology of agricultural products	31,023:	35,345:	35,345:	--
7. Tung nuts investigations	29,097:	33,075:	33,075:	--
8. Investigation of the hemicelluloses, pectin and cellulose in foods and feedstuffs	9,667:	10,000:	--:	-10,000 (1)

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
Covered into Treasury in accordance with Public Law 674	\$694:	- -	- -	- -
Unobligated balance	8,903:	- -	- -	- -
Total available	280,411:	304,875:	294,875:	-10,000
Transfer in 1945 estimates to "Salaries and expenses, Bureau of Plant Industry, Soils, and Agricultural Engineering," cereal crops and diseases	+26,201:	+26,201:	- -	- -
Anticipated deficiency for overtime pay	- -	-26,558:	- -	- -
Total estimate or appropriation	306,612:	304,518:	294,875:	

a/Excludes \$44,039 transferred pursuant to Executive Order 9069, dated February 23, 1942, to other appropriations, as follows: "Salaries and expenses, Bureau of Human Nutrition and Home Economics," \$28,854; "Salaries and expenses, Bureau of Plant Industry, Soils, and Agricultural Engineering," cereal crops and diseases, \$15,185.

DECREASE

(1) A decrease of \$10,000 resulting from discontinuance of hemicellulose investigations.

The work under this project consisted of experiments on the development of a precise method for the quantitative estimation of hemicelluloses in plant materials, and in animal excreta for the determination, as to whether farm animals can digest and utilize the hemicelluloses and lignocelluloses in their rations. The most promising method was found to be one involving the direct isolation of these organic complexes and weighing them as such. A paper giving the results of the investigations will be submitted for publication in the "Journal of Agricultural Research."

Although other phases of this problem could be advantageously studied, it is felt that their solution is not critical in relation to the war effort. Accordingly, this project has now been closed. The allocation of \$10,000 for this work is proposed as a decrease in the 1945 estimates. Unless contingencies arise to require the use of the 1944 allocation for carrying out other phases of the agricultural chemical investigations program, these funds will remain unobligated and will be returned to the Treasury.

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Agricultural chemical investigations: For conducting the investigations contemplated by the Act of May 15, 1862 (5 U.S.C. 511, 512), relating to the application of chemistry to agriculture; for the biological, chemical, physical, microscopical, and technological investigation of foods, feeds, drugs, plant and animal products, and substances used in the manufacture thereof; for investigations of the physiological effects and for the pharmacological testing of such products and of insecticides; for the investigation and development of methods for the manufacture of sugars, sugar sirups, and starches and the utilization of new agricultural materials for such purposes; for the technological investigation of the utilization of fruits and vegetables and for frozen pack investigations; [for the investigation of chemicals for the control of noxious weeds and plants;] and to cooperate with associations and scientific societies in the development of methods of analysis, [~~304,518~~] 294,875.

The proposed change deletes the authority "for the investigation of chemicals for the control of noxious weeds and plants" since the functions performed under this authority have been transferred to the Bureau of Plant Industry, Soils, and Agricultural Engineering by Research Administrator's Memorandum No. 5, approved by the Secretary on February 13, 1943, pursuant to Executive Order 9069, dated February 23, 1942.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	*\$16,378	\$12,235	\$12,235
Additional funds for overtime (appropriated; 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	1,400	26,558	26,558
Total cost of overtime (7 months in 1943)	17,778	38,793	38,793

*-Difference between overtime cost and supplemental appropriations.

WORK UNDER THIS APPROPRIATION

Objective: To devise means of reducing deterioration and spoilage of agricultural commodities between harvesting and processing, during storage, and after processing, and to find means of preventing deterioration of foods and feeds which must be stored under emergency and war conditions; to develop methods of processing, preserving, and packing foods to meet the requirements of war conditions; to develop needed feed supplies from farm-by-product materials not heretofore fully utilized; to assist by chemical and technological means in developing "deficiency" crops (e.g., tung nuts for tung oil production) for supplying products for which existing supplies are inadequate.

The Problem and its Significance: The importance of food in winning the war is generally recognized. The existing situation requires the solution of problems of processing, packaging, transportation and storage of food products which are radically different in many respects from those prevailing under ordinary conditions.

Thus, the shortage of refrigeration facilities on boats carrying food to Great Britain has necessitated development of methods of preservation not ordinarily employed. Increased need has developed for dehydrated and compressed foods, both for military use and for Lend-Lease shipment, with emphasis on better retention of color, flavor, and vitamins and (for military use) reduction in time required for rehydrating for cooking. Dehydration of foods conserves tin, reduces shipping weight, and prevents certain forms of spoilage. Necessity for building up reserves of food supplies in certain areas, including Great Britain, emphasizes the importance of keeping quality and of precautions for minimizing deterioration in storage after processing and packing. Large Government purchases of food necessitate chemical, bacteriological, and technological study of many problems arising in connection with processing, packaging, and keeping quality in meeting new conditions and situations. The great increase in army camps, especially in the South, has intensified the already existing need for more and cheaper winter feed for dairy cattle in that area. Shortage in some products is necessitating development of substitutes.

Assistance along these and similar lines is being rendered under this work program. Solution of many of these problems will have peace time benefits. Thus, the Lend-Lease shipment of food products of satisfactory quality may be expected to pave the way for new and expanded export markets. Solution of the problem (intensified by war conditions) of more and cheaper winter feed in the South will have permanent results in better nutrition and greater crop diversification in that area.

General Plan: In general, basic work is conducted under this appropriation, and applications made, at all field stations located in areas where production of the crops involved is greatest. The entire appropriation is being applied to work of the character indicated. Cooperation is maintained with the Army, Navy, and other bureaus of the Department, and State agricultural experiment stations.

Examples of Progress and Current Programs: The following examples of recent accomplishments under this appropriation are cited by financial projects to show progress on one or more aspects of the broader problems involved. Other aspects of these problems are cited as indicating the next logical steps to be taken in the research program. Work during the past year was centered exclusively on problems involved in the war effort.

Fruits, vegetables and other agricultural products of the South: Investigation was made of possible methods of utilization of cull and waste tangerines, in order to avoid wastage of this useful citrus fruit now greatly needed. Utilizing these waste products, processes were devised for recovery of oil and citric acid, which is in short supply, and of two types of sirup. One type of sirup is suitable for production of beverages and the other type, from which citric acid has been removed, is of bland flavor and can be used for a variety of purposes. Both types of sirup can be used for many sugar requirements. Commercial production of these products will be undertaken during the next citrus season.

Marked progress was made in improving keeping-quality and obtaining better retention of vitamins in concentrated citrus juices (orange, lemon, lime) for overseas shipment. Progress also was made in devising a suitable process for production of dehydrated orange juice. Patent application covering a process for this purpose has been made. Use of dehydrated citrus juices instead of the concentrated juices now being manufactured will mean a great saving in containers and overseas shipping space. It also may be possible to substitute other types of moisture-proof containers for tin cans. Concentrated citrus juices are now being produced in large quantity for shipment overseas to United States armed forces and for use of our allies. Technical assistance was rendered to the distillery constructed for production of alcohol from the waste liquor available from citrus residue drying plants in Florida, based upon procedures developed in work under this appropriation. Because of rapidly developing inadequacy of supplies of food and feed, it is desirable to devise all means possible for producing alcohol from waste products and, particularly, from non-food and non-feed materials.

Because of the shortage of tin cans, glass containers and pressure cookers for home preservation and other equipment (boilers, motors, blowers, etc.) required for preservation of fruits and vegetables by conventional methods of canning, and also by dehydration, intensive study was made of methods of preserving fruits by sulphuring and vegetables by brining, with accompanying acidic fermentation in greater or less degree as required. These methods are well adapted to war production in that no special equipment is required and cooperage (barrels, hogsheads, tanks) may be employed as containers for commercial use and crockery ware and the like may be used as containers for household use. Methods were developed for preservation of citrus fruits and small non-citrus fruits, such as strawberries and raspberries, by sulphuring and for preservation of string beans, peas, lima beans, carrots, kale, and certain other leafy vegetables by brining, with or without accompanying acidic fermentation. Descriptions of these methods for household use were distributed early in the Spring through the Extension Service throughout the United States. Over 360,000 copies of a bulletin on the process already have been distributed in response to requests. The methods are also in use commercially. Fruits and vegetables preserved in this manner in bulk storage can be subsequently packed in other ways if desired, or they can be held in storage in this form until consumed. The brining method for preservation of vegetables has been used in North Africa, thereby saving shipping space, packaging materials and utilization of facilities in this country. This area was formerly a source of fruits and vegetables for shipment to Europe, principally to France.

It has been estimated that there is a prospective 30 percent deficiency in winter feed supply in the South. It has been reported that, because of feed shortage, many farmers are reducing their dairy herds, thus aggravating the already existing milk shortage. Concentration of military

camps in the South has increased greatly the demand for milk, the supply of which in many sections has not been adequate in the past for even the normal population. Because of scarcity of farm labor, it is desirable that every possible effort be made to utilize fully the by-products from standard crops in supplying feed requirements. Work was continued on production of silage from cull sweetpotatoes and sweetpotato vines. Important progress also was made in developing a low-cost farm-scale method for dehydration of sweetpotatoes for cattle feed, using both culls and sweetpotatoes grown specifically for the purpose. Feeding tests, with dairy cattle, in cooperation with the North Carolina Experiment Station gave satisfactory results. In these ways, the available winter feed supply of the South can be increased at little cost by preserving large quantities of material previously wasted. This information is being distributed throughout the sweetpotato producing areas.

Sugars and sirups investigations: A process has been developed for recovery and refining of sugarcane wax as a by-product of the cane sugar industry. A method has also been perfected for decolorizing the wax. Tests have shown that this wax can be employed satisfactorily as a substitute for various waxes (e.g., montan, carnauba, candelilla, and Japan waxes) which are either unavailable or are in short supply. These waxes are important for various critical uses, such as waterproofing of various types of military equipment, waterproofing and treatment of leather (including army shoes), waterproofing and lubrication of marine cordage, as expanders and blending agents in molding rubber articles, etc. Technical assistance is being given to interests which are planning early commercial production.

Further developments were made in the process for production of sugar from sorgo. Special attention was given to development of by-products, particularly aconitic acid compounds, some of which are now in use in plastics and rubber products to prevent brittleness and cracking at low temperatures. Because of low temperatures at high altitudes, this is important in the case of plastics and rubber products used in airplanes. Aconitic acid as a by-product of sorgo sugar, represents a large natural source of supply, greater in quantity and available at lower cost than the present synthetic source. The seed obtainable from sorgo represents a by-product feed, not available from sugarcane, which is greatly needed in view of the present feed shortage. The residual fiber, bagasse, is recognized as a valuable ingredient of greatly needed mixed cattle feeds. Important progress was made in devising a means of reducing the large loss of sugar, approximately 200,000,000 pounds annually, which results from necessary holding of about 50 percent of the sugar beet crop in storage for approximately 40 days annually. Reduction of this loss is especially important because the full investment of capital and labor in the crop has already been made.

Investigations on pharmacology of agricultural products: During the past year, numerous samples of dehydrated vegetables have been analyzed for vitamins, using rats and other small laboratory animals for this purpose. This work has been done in cooperation with the dehydration

program in the Western Regional Research Laboratory and is vitally important as a check on the accuracy of chemical and physical methods that are being used for routine testing. Special emphasis is being given to the vitamin A value as determined by bioassay on albino rats, since the tremendous demand for dehydrated vegetables of good quality to meet the requirements of Lend-Lease and the military forces makes this work of fundamental and very immediate importance. Pharmacological investigations on products developed at the research laboratories of the Bureau will be conducted during the coming year for the purpose of evaluating the products.

Investigations on enzymes and phytochemistry: A new process for preparing grain for fermentation, for the production of alcohol, especially applicable to wheat, has been devised under an allotment to this Bureau from the Special Research Fund and is reported under that heading. Related aspects of the problem have been studied under this appropriation.

It has been found that a substantial fraction of the wheat proteins may be removed in pure form as a by-product before fermentation begins. The extra value of this protein is still uncertain but is considerable. By removing the protein before fermentation, the distilling operations are made easier and cheaper because its presence clogs up the machinery. It is planned to study the uses of this protein in cooperation with the Western Regional Research Laboratory. Uses as feed, food, adhesives, source of glutamic acid, etc., will be worked on. It is understood that at present small amounts are being manufactured commercially and used as cattle feed.

The War Production Board is now engaged in making extensive tests on the isolation of this protein at a small distillery. In the meantime, commercial operations on a restricted scale are being started in many distilleries throughout the country. Patent applications have been filed covering essential features of this process.

Investigations of the chemical composition of dehydrated vegetables and the evaluation of any changes in chemical composition, natural color, palatability and food value are being made as an indispensable part of the development and improvement of methods of handling and processing the vegetable crop. Product samples of several pilot plant runs of the dehydration process were taken at various stages of the operations for evaluation of moisture content, retention of flavor, vitamins, color, texture, enzymes and rehydration characteristics. Changes in color which occur during the processing and storage of dehydrated vegetables have been measured by several methods. Substantial changes in the color of water extracts subjected to various conditions have been observed and have led to the development of a water extract color method which shows considerable promise as a relatively simple means of following general product quality.

Fruits, vegetables and other agricultural products of the West: A type of cabinet dehydrator that will dry about one ton of fresh produce per day has been designed and tested in practical operation. The cost of material for construction ranges from \$500 to \$1,000. Particular attention has been paid to the use of noncritical construction materials wherever possible. During the past two years, the Indian Service of the Department of Interior has been supplied with technical assistance in the establishment of a dehydration program among the various Indian reservations in the western States. Their canning program has been curtailed, due to the lack of metal containers, and they needed a method of food preservation whereby they could save large quantities of vegetables, fruits and other food products. Several types of cabinet dehydrators were tested and operated at the Phoenix Indian School, Phoenix, Arizona. One of these dehydrators was sent to Colorado and during the past year, these two reservations have been operating throughout their growing seasons.

These dehydrators have proved to be satisfactory for institutional use and plans are being made to construct a number of them in such places as penal institutions, State hospitals and community centers. One such group already is planning to establish a series of these dehydrators throughout the western States.

During the year, important progress has been made on the problem of separating nightshade berries, other weed seeds, loose skins, etc., from shelled canning peas. The presence of these foreign materials is so prevalent that in some important pea-canning areas from 5 to 10 percent of the shelled peas must be rejected in addition to a larger quantity that are not harvested at all because of weed contamination. The process developed consists of a froth flotation system that permits good peas to sink and the other material to be floated away. A number of demonstrations of the value of this process have been made under actual cannery conditions and several commercial concerns are making definite plans to install this equipment in their plants before next season. This process has been protected by a public service patent.

Pear syrup that is entirely satisfactory in color and flavor has been prepared from cull pears and pear-canning waste. This syrup could be used as a table syrup or in industrial applications such as a humidifying agent in tobacco similar to the manner in which apple syrup has been employed. Experimental batches of pear syrup from waste material have been found to be considerably above the legal tolerance for arsenic. Preliminary work indicates that this arsenic can be removed by resin ion exchangers, and it is planned to continue investigations on this phase.

At the present time, there is considerable interest in the sulphuring of vegetables prior to dehydration. This interest arises from reports to the effect that the treatment has a preservative value for Vitamin

C and, in the case of cabbage, yields a dehydrated product having better color and storage qualities. Sulphur treatment has been suggested for cabbage, potatoes, green peas and snap beans and is widely used in England, Canada and Australia at the present time. So far, the treatment has not been widely applied in this country because of a desire to avoid the use of sulphur in food processing wherever possible. Military needs, however, are so pressing that it is considered advisable to investigate carefully the results obtained by sulphuring as a preparatory treatment in the dehydration process.

Fundamental investigations in microbiology of agricultural products:

Because of the great expansion in production of dried whole egg powder for use of the Army and Lend-Lease, work is being developed mainly along the following lines: (1) studies of operating conditions and sanitary requirements for plants producing dried whole egg powder for the Army and Lend-Lease, (2) bacteriological examination and studies of quality of samples of dried whole egg powder taken from offerings submitted for purchase under the Lend-Lease Act, (3) storage studies to determine the effect of various factors on the storage life of spray-dried egg powder. An allotment of Lend-Lease funds has been made to cover certain aspects of the work on dried eggs.

The tremendous expansion of the dried egg industry necessitated by the requirements of the Army and Lend-Lease for spray-dried whole egg powder resulted in the opening of over 115 new drying plants. The personnel of many of these plants frequently had no knowledge of the proper procedures and the sanitary requirements necessary for operation. At the request of the Food Distribution Administration, a study of the conditions existing in these plants is being carried on. This study was planned to instruct operators as to basic sanitary requirements and to determine more definitely the most important sanitary requirements of commercial drying installations. Field studies have been conducted using a mobile laboratory to visit about 50 percent of the drying plants now offering egg powder for Lend-Lease purchase. A great deal of information has been obtained by the personnel of the mobile laboratory relative to the sanitary and engineering features of various types of commercial dryers.

In addition to the field work, approximately 9,000 samples of dried whole egg powder, taken from offerings submitted for purchase under the Lend-Lease Act have been examined for total bacterial counts, coliform bacteria, species of food poisoning types of bacteria and for edible qualities as judged by flavor, texture, color, odor and solubility. The results have been used by the Food Distribution Administration in revising purchase specifications and have served as a guide in directing the movements of the mobile laboratory to the establishments most in need of instructions.

A number of storage experiments have been conducted to determine the effect of such factors as moisture, temperature, quality of liquid egg used, type of dryer, the addition of antioxidants, inlet and outlet

temperatures of dryers, etc., on the storage life of spray-dried powder. Changes in palatability scores, cooking qualities, solubility and viable bacterial count were used as indices of storage change. The work on palatability and cooking qualities was conducted by the Bureau of Human Nutrition and Home Economics which was cooperating in this work. It was found that egg powders produced with an initial moisture content of 5.0 percent or less were much more stable than egg powders produced with initial moisture concentrations higher than 5.0 percent; that bacterial growth will not occur in properly dried and stored spray-dried powder unless the relative humidity of the storage atmosphere exceeds 90 percent at 30° C.; that death of bacteria in stored spray-dried powder can be associated with the chemical changes involved in loss of solubility; that powder will not mold during storage at relative humidities less than 85 percent at 30° C.; that, although changes occur at all temperatures of storage, 30° C. is the highest short-time storage temperature that can be used with good quality powder to avoid rapidly accelerated changes, and 10° C. is the highest long-time storage temperature that can be employed without the development of such changes; and that spray-dried powders produced under sanitary conditions from low count liquid egg can be stored more safely at all temperatures than powders produced with high initial bacterial counts.

Tung nuts investigations: Tung oil is the preferred coating material for protecting large quantities of military equipment from corrosion and water damage. Imports have ceased and it is important to increase domestic production as much as possible. A process has been devised and tested on a pilot plant scale for recovering 99.5 percent, or more, of the oil in tung nuts by solvent extraction, thereby eliminating the large percentage loss now incurred by present pressing methods. Technical assistance is being given to commercial interests which are planning commercial production by this process. If equipment is made available for use in this process, a large number of tung oil presses and expellers can be made available for handling increased production of oils of other types (e.g., soybean and peanut). In order to effect economy in labor and transportation of raw material to solvent extraction plants, a simple portable tung fruit huller has been devised, in cooperation with agricultural engineers. These hullers, several of which it is planned to build this season, will reduce by 50 percent the weight of material to be hauled to processing plants.

(d) Agricultural Engineering Investigations

Note: Appropriation under the above title has been transferred to and estimated for under "Salaries and expenses, Bureau of Plant Industry, Soils, and Agricultural Engineering" pursuant to Research Administrator's Memorandum No. 5, issued under Executive Order 9069 of February 23, 1942.

(e) Naval Stores Investigations

Appropriation Act, 1944	\$115,100
Budget estimate, 1945	112,100
Decrease	<u><u>-3,000</u></u>

PROJECT STATEMENT

Project	: 1943	: 1944	: 1945	: Increase or
	: (estimated)	: (estimated)	: (estimated)	: decrease
1. Naval stores investigations::	:	:	:	
(a) Investigation of naval stores production, processes and equipment	: \$34,512:	: \$38,966:	: \$38,966:	: - -
(b) Investigation of composition, properties, components and derivatives of naval stores	: 27,588:	: 34,267:	: 34,267:	: - -
(c) Investigation of uses, handling and transportation of naval stores	: 30,870:	: 38,867:	: 38,867:	: - -
(d) Improvements and repairs at the naval stores station, Olustee, Florida ..	: - -:	: 3,000:	: - -:	: -3,000 (1)
Covered into Treasury in accordance with Public Law 674	: 366:	: - -:	: - -:	: - -
Unobligated balance	: 25,120:	: - -:	: - -:	: - -
Total estimate or appropriation	: 118,456:	: 115,100:	: 112,100:	: -3,000

DECREASE

- (1) A decrease of \$3,000 due to elimination of a nonrecurring item for improvements in roads and drainage ditches at the Naval Stores Station, Olustee, Florida.

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	: \$6,166:	: \$13,454:	: \$13,454
Additional funds for overtime (appropriated, 1943; estimated supplemental, 1944; and included in budget estimate, 1945)	: - -:	: - -:	: - -
Total cost of overtime (7 months in 1943)	: 6,166:	: 13,454:	: 13,454

WORK UNDER THIS APPROPRIATION

Objective: To increase the usefulness and fields of use of naval stores, particularly to develop products from naval stores that are vital for war purposes; specifically, to conduct research on improved methods of production, on substitution of critical materials normally required in naval stores plant operation by noncritical materials to help meet the increased emergency needs for naval stores and on the development of new and diversified products from naval stores for war purposes now and to serve later as a means of building a more satisfactory post-war economy than has heretofore prevailed, thus improving the economic status of the increasing number of low-income farmers in the South.

The Problem and its Significance: Of special significance at the present time are problems dealing with the utilization of naval stores and derivatives therefrom to meet such specific war requirements as the development of derivatives used in making synthetic rubber, resins, plastics, driers, and drying oils; products for rot-proofing of sandbag and military fabrics; and derivatives useful for special military purposes such as flame throwers, incendiaries, smoke screen materials and smokeless powder.

The acute rubber situation has created an increasing need for "intermediates" for making synthetic rubber and various chemicals and derivatives needed in the compounding of such rubbers, particularly for making military and heavy-duty tires and other manufactured rubber goods. Turpentine derivatives have been obtained which can serve in actual rubber synthesis both individually and in compounding products to impart to synthetic rubbers specifically desired properties.

Pine oleoresin is the source of raw materials for synthetic rubber, protective coatings, for drying oil promoters, soap, various chemicals, such as camphor, cymene and styrene derivatives, and other chemicals vital for war needs. It is an abundantly available, annually reproducible crop with potentialities for increased production.

To meet the increasing demand for naval stores due to war requirements will require, in view of the scarcity of labor and the difficulty of obtaining equipment involving critical materials, the development of improved processing and suitable equipment from available structural materials. The increasing shortage of metal containers for naval stores products necessitates study of methods of collecting pine gum, of grading and evaluating gum and of packaging, storing, and handling of rosin and turpentine, its principal commercial products.

General Plan: The research and technical work conducted under this appropriation comprises studies on production, processes, equipment, composition, properties, components and derivatives, and on uses, handling and transportation of naval stores. Results obtained from studies on composition and derivatives constitute a basis for studies on new uses and applications, particularly as these affect the war effort. Wherever possible, results obtained from studies on composition and new uses are translated into larger than laboratory scale work at the Naval Stores Station. The appropriation for "Naval stores investigations" is devoted to work connected directly or indirectly with the war program, but as far as possible, also with the view to their effect on the development of a sound post-war economy in the naval stores industry.

Examples of Progress and Current Program:

Naval stores investigations: The program for Naval Stores Investigations is being conducted with emphasis on those objectives having the greatest significance to war needs. The work of the Naval Stores Research Division has resulted in the issuing of 3 patents and 13 other publications during the past fiscal year.

Investigation of naval stores production, processes and equipment: Designs for processing equipment, still sheds and settings and improved techniques of operation have been made available to producers. The Government patented process of gum refinement has been abbreviated resulting in the saving of critical materials and labor, yet obtaining the same results. Much progress has been made on a satisfactory method of reclaiming gum wastes encountered in plant operation. Equipment for the study of turpentine as a source of synthetic rubber intermediates has been partially erected. Many plastic cups and coating materials for old iron cups were tested to find a suitable substitute for iron and zinc. The results of a ten-year study of the effect of slash and longleaf gum on cup material and accessories were summarized and reported. Tests on various types of rosin packages were made. All such information obtained by the Division was made available to the turpentine farmers through the Naval Stores Cooperative Agents.

Current Program: Development of synthetic rubber intermediates from turpentine; crude gum grading standards; protective coating to extend life of metal turpentine cups now in use; methods of preserving wood rosin barrels to permit their replacement for metal drums now in use; methods of gum storage to permit year-round operation. Introduction of the information obtained by the Division to the gum farmers and processors through the Naval Stores Cooperative Agents.

Investigation of the composition, properties, components and derivatives of naval stores: Laboratory methods for the production of two intermediates (myrcene and isoprene) for the production of synthetic rubber from turpentine have been developed. Myrcene, heretofore a laboratory curiosity derived from bay oil and hop oil, has been made readily obtainable from one of the major components of turpentine in relatively good yield and made available to commercial laboratories for testing in rubber synthetics. These tests have shown that excellent synthetic rubber (both solid and latex form) are obtainable from myrcene. Commercial exploitation of myrcene has already been begun; isoprene, the other intermediate for synthetic rubber from turpentine, is the accepted co-polymer for butyl-rubber and for certain special Neoprene and Buna type rubbers. Rosin polymers have been developed which show drying properties. Several new non-glycerol derivatives of rosin have been developed which show promise of supplementing critical ester gum (using glycerol) for use in protective coatings. Improved accessory equipment for vacuum fractionation has been developed.

Current program: Work on larger scale production and utilization of myrcene from turpentine for synthetic rubber will be continued; laboratory work on the production of isoprene from turpentine will be extended; the properties of the synthetic rubbers made from isoprene or myrcene, or both, will be studied; methods for the production from turpentine of derivatives suitable for use as drying oil promoters, especially for use with drying oils; development from pine gum of high melting resins as supplements and replacements for synthetic resins, imported fossil gum and other imported resins.

Investigations of uses, handling and transportation of naval stores: The copper soaps of tall oil and rosin have been found suitable to supplement and replace copper naphthenate for preservatives for sandbagging and camouflage fabrics. Assistance was given the Corps of Engineers in the preparation of emergency specifications for treating sandbags in the field. A portable, flameproof, simulated grass mat was developed for the Navy. A study was made of the reaction of lactic acid with rosin. Certain reaction products were formed which gave better water resistance with linseed oil varnish than the standard spar varnish made with ester gum. Concrete curing compositions meeting federal specifications were prepared from certain rosin-lactic acid resins. Information was contributed leading to a revision of federal specifications for paint driers to permit use of resinsates. Resinate driers having a satisfactory stability on solution were prepared. Statistics on production, consumption and distribution of naval stores have been compiled on a quarterly basis and distributed. Surveys of stocks beginning with November 1942, have been published monthly. Statistical data on other naval stores, requested by war agencies, have been collected.

Current program: Development of suitable paint driers from resinsates; satisfactory methods for evaluating the effectiveness of such driers; surface coating resins from rosin and modified rosins using available or noncritical materials, surface coating compositions with a minimum of drying oils; resins suitable for use in concrete curing; rotproofing preservatives for sandbags, camouflage and other cellulosic fabrics from rosin; naval stores products suitable for use in weather and flameproofing and heat-reflecting treatments for tent and other fabrics for military purposes; materials from pine gum suitable for use as compounding ingredients in synthetic rubber. Compilation of statistical data pertaining to naval stores on a monthly and quarterly basis.

(f) Regional Research Laboratories

Appropriation Act, 1944	\$3,959,385
Proposed transfer in 1945 estimates:	
To "Salaries and expenses, Office of Administrator, Agricultural Research Administration" (for planning and coordination of the programs of the laboratories)	-24,895
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+305,550
Total anticipated available, 1944	4,240,040
Budget estimate, 1945	4,244,600
Increase	<u>+4,560</u>

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Northern regional research laboratory	\$934,345	\$1,042,000	\$1,043,000	+\$1,000 (1)
2. Southern regional research laboratory	931,525	1,019,000	1,020,600	+1,600 (1)
3. Eastern regional research laboratory	886,487	1,014,600	1,015,300	+700 (1)
4. Western regional research laboratory	872,615	1,032,100	1,033,200	+1,100 (1)
5. General administra- tive expenses	106,831	132,340	132,500	+160 (1)
Covered into Treasury in: accordance with Public: Law 674	5,390	- -	- -	- -
Unobligated balance	203,607	- -	- -	- -
Total available	3,940,800	4,240,040	4,244,600	+4,560
Transferred from "Con- servation and use of agricultural land re- sources"	-4,000,000	- -	- -	- -
Transferred to (as shown in Budget schedules)	+59,200	+24,895	- -	- -
Anticipated deficiency for overtime pay	- -	-305,550	- -	- -
Total estimate or appropriation	- -	3,959,385	4,244,600	

INCREASE

- (1) An increase of \$4,560 for overtime pay required under the War Overtime Pay Act of 1943.

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

[Regional Research Laboratories]

[For all salaries and expenses, including personal services in the District of Columbia, necessary to enable the Secretary to continue] Regional research laboratories: For continuing the researches established under the provisions of section 202(a) to 202(c), inclusive, of title II, and subject to the provisions of section 393 of title III, of the Agricultural Adjustment Act of 1938 (7 U.S.C. 1292, 1393), including research on food products of farm commodities, [\$3,959,385] \$4,244,600.

By Agricultural Research Administrator's Memorandum No. 5, approved by the Secretary on February 13, 1943, issued pursuant to Executive Order 9069, dated February 23, 1942, the Regional Laboratories were placed in the Bureau of Agricultural and Industrial Chemistry, which organization, and its predecessor, the Bureau of Agricultural Chemistry and Engineering, has had the responsibility for the operation of the Laboratories since their establishment. Accordingly, the Budget estimates for 1945 provide for the inclusion of the appropriation language for these laboratories as a subappropriation under "Salaries and expenses, Bureau of Agricultural and Industrial Chemistry."

The change proposed in the previous language merely deletes unnecessary matter and inserts the title in connection with establishing this item as a subappropriation under "Salaries and expenses, Bureau of Agricultural and Industrial Chemistry."

Statement of Overtime Costs

	: 1943	: Est. 1944	: Est. 1945
Overtime absorbed	\$239,910	\$190,405	\$190,405
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	- -	305,550	310,110
Total cost of overtime (7 months in 1943) .	239,910	495,955	500,515

WORK UNDER THIS APPROPRIATION

Objective: To develop, by research, new scientific, chemical and technical uses and new and extended markets and outlets for farm commodities, and products and by-products thereof, such as corn; wheat; soybeans; cotton; sweetpotatoes; peanuts; apples; vegetables; tobacco; milk products; animal fats and oils; tanning materials, hides, skins, and leather; potatoes; alfalfa; fruits; poultry; and agricultural residues, with special and exclusive emphasis during the war period on the development of replacements or substitutes for critical and strategic materials vital to the conduct of the war.

The Problem and its Significance: A basic problem and need of agriculture under normal peacetime conditions has been to develop new and extended uses and expanded outlets for its products and by-products. The war has emphasized the importance of the program of industrial utilization of farm commodities in certain and many of its more immediate aspects, in order to meet deficiencies in strategic and critical raw materials and to develop substitute replacement materials of great value for both civilian and military needs.

The requirements of war have increased the national consumption of most of the necessities of life and at the same time, the importation of many essential raw materials has been stopped. As the war continues, the list of materials of which the supply is inadequate is growing in length. Replacements and substitutes are necessary for these materials, particularly since the exigencies of our war effort are increasing production in the industries which make use of these raw materials.

Research on the industrial utilization of farm commodities under war conditions must recognize the role which the products of the farm must play in meeting the needs of the Nation and our allies in the present emergency. The adequate production of food, feed and fiber is the prime requirement of agriculture, but agriculture is ably serving an important dual role in providing many industrial products essential to the war effort. Many low-grade and waste farm materials, as well as food crops, contain appreciable quantities of valuable constituents which may serve for the production of plastics, synthetic rubber, motor fuels and lubricants, building materials, cloth filler and substitutes, fibers, protein meals, films, adhesives, medicines, pharmaceuticals, solvents, hormones, and other vital commodities. Methods of making food products available to our armed forces and our allies, from the standpoint of both preservation and shipping space requirements, present a critical problem which must be carried through the research channels for development of suitable methods for producing, preparing, packaging, storing and delivering frozen foods and of reducing the weight and bulk of foods through dehydration. Both dehydrated and frozen foods have the advantage of not normally requiring the use of metallic packages.

Ample supplies of most farm commodities, together with burdensome surpluses of agricultural residues, constitute a reservoir from which to draw raw materials for such products and processes as are developed, whether during normal times, the present war emergency or the post-war period.

General Plan: The research work under this appropriation covers the principal agricultural commodities produced in the 48 States. Through chemical, physical and biological laboratory investigations, it is planned to develop new products or processes involving these commodities, and through chemical engineering research on a pilot plant scale, to establish the commercial feasibility of the given product or process leading to commercial development and use of these farm products.

In view of the imperative war needs, the long-term purpose of stimulating industries by processing agricultural commodities for conversion into profitably produced industrial products has been set aside, while exclusive and increased emphasis is being placed on the development and improvement, from farm commodities, of products and processes which have immediate significance and application to war needs. Long-term fundamental studies will be prosecuted only to the extent that such information is needed for a specific war use. Short-term problems, the solution of which can contribute to the war program, will be emphasized.

Indicated below are the States to be served, together with the commodities to be given initial attention, by each of the laboratories:

Northern Regional Research Laboratory, Peoria, Illinois

<u>Area</u>	<u>Commodity</u>
Illinois	Agricultural
Indiana	residues
Iowa	Corn, wheat
Kansas	and other
Michigan	cereal
Minnesota	crops
Missouri	Soybeans and
Nebraska	other oil-
North Dakota	seed crops
Ohio	
South Dakota	
Wisconsin	

Southern Regional Research Laboratory, New Orleans, Louisiana

<u>Area</u>	<u>Commodity</u>
Alabama	Cotton
Arkansas	Sweetpotatoes
Florida	Peanuts
Georgia	
Louisiana	
Mississippi	
Oklahoma	
South Carolina	
Texas	

Eastern Regional Research Laboratory, Wyndmoor, Pennsylvania

<u>Area</u>	<u>Commodity</u>
Connecticut	Apples
Delaware	Vegetables
Kentucky	Tobacco
Maine	Milk products
Maryland	Potatoes
Massachusetts	Animal fats
New Hampshire	and oils
New Jersey	Tanning mater-
New York	ials, hides,
North Carolina	skins and
Pennsylvania	leather
Rhode Island	
Tennessee	
Vermont	
Virginia	
West Virginia	

Western Regional Research Laboratory, Albany, California

<u>Area</u>	<u>Commodity</u>
Arizona	Apples
California	Alfalfa
Colorado	Fruits
Idaho	Potatoes
Montana	Vegetables
Nevada	Poultry
New Mexico	Wheat
Oregon	Tanning mater-
Utah	ials - West-
Washington	ern Hemlock
Wyoming	Bark

It will be noted that research on certain of the commodities has been divided between two laboratories. Such division of effort is based on the importance of the commodity under investigation in the regional areas to which assigned. Careful consideration has been given to the composition of these commodities which suggest different types of utilization and to the coordination of the research activities of the laboratories concerned.

A composite statement of these joint projects is given below. Complete project statements for each laboratory appear on subsequent pages.

	: Northern	: Eastern	: Western	: Total
	: Laboratory:	: Laboratory:	: Laboratory:	
Corn, wheat and other	:	:	:	:
cereal crops utilization	:	:	:	:
investigations (Northern),	:	:	:	:
and wheat utilization in-	:	:	:	:
vestigations (Western):	:	:	:	:
1943 Actual	\$592,738:	- -:	\$79,966	\$672,704
1944 Estimated	605,000:	- -:	75,700	680,700
1945 Estimated	605,600:	- -:	75,800	681,400
Apple utilization inves-	:	:	:	:
tigations:	:	:	:	:
1943 Actual	- -:	75,951:	59,525	135,476
1944 Estimated	- -:	113,800:	79,100	192,900
1945 Estimated	- -:	113,900:	79,200	193,100
Vegetable crop utiliza-	:	:	:	:
tion investigations:	:	:	:	:
1943 Actual	- -:	34,229:	229,179	263,408
1944 Estimated	- -:	47,600:	382,500	430,100
1945 Estimated	- -:	47,700:	382,900	430,600
Potato utilization	:	:	:	:
investigations:	:	:	:	:
1943 Actual	- -:	111,965:	27,512	139,477
1944 Estimated	- -:	85,000:	59,600	144,600
1945 Estimated	- -:	85,000:	59,700	144,700
Tanning materials, hides,	:	:	:	:
skins and leather utili-	:	:	:	:
zation investigations	:	:	:	:
(Eastern), and	:	:	:	:
Western hemlock bark as	:	:	:	:
an emergency source	:	:	:	:
(Western):	:	:	:	:
1943 Actual	- -:	58,769:	10,407	69,176
1944 Estimated	- -:	73,400:	22,300	95,700
1945 Estimated	- -:	73,500:	22,300	95,800

The research program for each laboratory, by commodities, is briefly discussed in the following statements:

Northern Regional Research Laboratory

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):
1. Construction and equipment of building	\$7,904:	- -:	- -
2. Agricultural residues utilization investigations	209,069:	218,500:	218,700
3. Corn, wheat and other cereal crops utilization investigations a/.....	592,738:	605,000:	605,600
4. Soybeans and other oilseed crops utilization investigations	124,634:	218,500:	218,700
Covered into Treasury in accordance with:			
Public Law 674.....	1,200:	- -:	- -
Unobligated balance	19,705:	- -:	- -
Total available	955,250:	1,042,000:	1,043,000
Transfer from "Conservation and use of agricultural land resources"	-960,750:	- -:	- -
Transfer to "Salaries and expenses, Library"	+5,500:	- -:	- -
Anticipated deficiency for overtime pay	- -:	-88,605:	- -
Total estimate or appropriation	- -:	953,395:	1,043,000

a/ Joint project with Western Regional Research Laboratory.

Examples of Progress and Current Program:

Construction and equipment of building: This project was continued in the fiscal year 1943 for the construction of a solvent-storage building, estimated at \$8,000, for storing large quantities of volatile flammable solvents used in the laboratories and pilot plant. With the completion of this solvent storage building, all phases of the initial building construction and installation of fixed laboratory equipment have been completed, and the project closed. However, certain construction items, as well as special equipment items, necessarily are required from time to time as an integral part of the research program facilities. Such construction and equipment items would not be a part of the original project which provided for initial construction and standard equipment installation as related to the laboratory building, and, therefore, will be chargeable to the various commodity projects requiring such facilities.

Agricultural residues utilization investigations: As the war has progressed, increasing emphasis has been directed to the importance of the problem of industrial utilization of agricultural residues, or farm wastes. This has been due largely to the growing scarcity of many industrial raw materials and the necessity of developing all manner of substitutes or new articles. Even in the case of agricultural residues, certain local shortages have developed, and industries depending on the

use of these sources have been forced to consider substitution of other residues to meet their required schedules. Nevertheless, the tremendous unused volume of these residues, the variety of their properties, their wide distribution and their unavailability for use directly as feed sets them apart as our one inexhaustible agricultural surplus.

The problems undertaken when the Laboratory was occupied were those which appeared to be applicable to either peacetime or emergency requirements. These endeavors have been modified to meet those specific problems of most immediate importance to the war effort. As the objective of one problem has been reached, other problems of immediate need to the war effort have been undertaken.

The development of new materials from agricultural residues to supply wartime demands for substitute materials offers many possibilities of which the following are representative of definite accomplishments.

Cellulose pulps for military uses: Special cellulose pulps produced from agricultural residues have been developed through the pilot plant stage and have been shown to be satisfactory for use for certain confidential military equipment. Our objective in this project has been reached, and the work finished.

Noreseal: A cork substitute used to seal closures used in the bottling industry has been developed through the semi-pilot plant stage. Based on about 7,000 practical plant bottling tests, Noreseal has proved the equivalent of cork. Noreseal is composed entirely of agricultural materials and contains about 30 percent peanut shell pith. A pilot plant to study manufacturing procedures and costs is being built by an industrial trade association to commercialize this development. The problem was undertaken during the cork shortage, since 35,000 tons of cork are annually used for this purpose. Even with the present improved cork situation, there is evidence, because of the properties of Noreseal, that it will find industrial use.

Noreplast: A thermo-setting plastic, composed of 75 percent agricultural materials, after more than a year's development in laboratory and pilot plant study, followed by practical molding tests in five commercial plants, has been released to industry. It has been demonstrated by these practical industrial trials that military articles, such as safety razor and the distributor box for the jeep, mold satisfactorily in commercial molding cycles. Noreplast has attracted the attention of the Ordnance Department, the Quartermaster Corps and the War Production Board, and these agencies are cooperating in studying its military uses. It has the advantage of containing 60 percent dry ground agricultural residue fibers, such as the cereal straw, flax shives, hemp hurds, cornstalks, etc., which make possible the procurement of the fibrous portion of the plastics in many localities. It contains only 25 percent phenol-formaldehyde, about half the amount now generally used, but it has strength, molding properties and industrial practicability of the same order as general purpose 50 percent phenol-formaldehyde 50 percent wood flour molding powders. Tests on the military

razor molded from Noreplast indicate some deficiency in moisture resistance. Efforts are being made to improve this. Present indications are that there will be a wide industrial use of Noreplast. The manufacture of Noreplast appears to fit in particularly well with postwar agricultural community activities.

Several projects, temporarily discontinued in favor of more urgent war problems, have themselves become urgent and are being vigorously prosecuted.

Fermentable sugars for alcohol and Butylene Glycol manufacture from agricultural residues: In 1940, a project was undertaken to produce sugars suitable for fermentation or feed from agricultural residues. With the large surplus of wheat and corn available for alcohol production in 1941, this work was held in abeyance. The present greatly expanded requirements for food and feed make the problem of producing alcohol from non-food materials extremely important. The process has been again taken up and is being pushed as rapidly as possible towards the pilot plant stage, looking to full-scale development. Based on considerable laboratory work, the process appears to be an improvement over the German process, which has been supplying Axis sugar needs during the war, or the American process, a modification of the German process now under pilot plant trial in this country.

Specifically, the time cycle of the process is less than half as long as the above-mentioned processes, making the capital investment and critical material bill less costly per ton of sugar produced. In industrial alcohol production, it is the practice to ferment a 10 percent to 15 percent sugar solution. The process under investigation is believed to produce such a concentration of sugar directly, while the German or the American processes produce a much weaker solution, with consequent high steam costs in alcohol recovery.

In 1943, alcohol production calls for an estimated use of 135 million bushels of grain; in 1944, the requirement is 180 million bushels. Assuming successful development, the new process will produce 5 million gallons, equal to 2 million bushels of grain, from 100,000 tons of corn-cobs, sugarcane bagasse or cereal straws, while 100,000 tons of hemp hurds will produce 4.3 million gallons of alcohol.

Within a radius of 100 miles in Central Illinois, our surveys show 100,000 tons of corn-cobs accumulating in elevators. Within a radius of 160 miles in Illinois and Western Indiana, 160,000 tons accumulate. The 42 hemp mills being built in the Middle West will produce 400,000 tons of hemp hurds, or waste, the only present use for which is fuel. For fuel only two-thirds of the supply will be required. These hemp mills are located in the soft coal region of the Middle West and the fuel value of the waste will be very low. In Louisiana, at least 100,000 tons of sugarcane bagasse are available. In Kansas and the Dakotas, given the farm labor and baling machinery, one million tons of wheat straw can easily be secured. This tonnage of residues would produce 80 million gallons of alcohol and would be equivalent to 32 million bushels of grain.

Raw material surveys and collection problems: Every new use of agricultural residues is based on the economics of supply and collection. Surveys of the availability of various residues for industrial use, together with a study of improvements in methods and economics of collection are continuously active. Cooperation with the farm equipment manufacturers on the problem has resulted in notable improvements in machinery for the collection and handling of residues.

Corn, wheat and other cereal crops utilization investigations: Cereals, besides being the most economical human food, are also a convenient and, frequently, a relatively cheap raw material source for the production of many essential products. The maximum economy in their use results from direct rather than indirect means of utilization. For example, when converted into livestock products, about 86 percent of their caloric value as human food is lost. This is exclusive of the loss of supplementary feeds used and of human energy required in producing and processing the livestock.

The total annual domestic production of all cereals averaged 119 million tons in the 1909-13 period and 114 million tons in the 1929-38 period, while in 1941 and 1942, production rose to 136 and 156 million tons, respectively. Corn alone accounts for approximately 1/2 of this tonnage, wheat for 1/5, oats for 1/6 and barley for 1/15. The other cereals combined constitute only about 5 percent of total production.

From the standpoint of the principal chemical constituents, all cereals show a fairly close similarity. However, in minor chemical constituents and in physical characteristics, wide differences exist. It is these differences which are chiefly responsible for consumer preferences for various uses, particularly food uses. Thus, in general, each cereal is preferred for some specific use. The physical characteristics of the cereal determine largely the processing procedure that must be applied for efficient and proper separation of the kernel into its component parts. In some instances, the differences in physical characteristics occurring between cereals are great enough to require radically different processing procedures. These chemical and physical differences, although presenting difficulties, usually are not sufficiently great to prevent absolutely the substitution and interchangeability of one grain for another.

In the field of industrial utilization, important researches have been conducted on grain for the production of alcohol, starch, proteins, oils and related products. Deficiencies in strategic and critical raw materials such as tin, rubber, starch and drying oils offer opportunities for the development of replacement materials of great value both to the civil population and the armed forces. For example, rubber substitutes and extenders from starch and cereal oils; plastic containers for processing of foods from protein of cereals; and starch and drying oils, to supplement the dwindling supplies of these materials from foreign sources, as well as motor fuels to supplement our supplies of gasoline;

replacements for imported adhesives; vital war chemicals; and, from corn, a new therapeutic agent for war wounds, are fields in which work is now in progress.

Penicillin: Based on the fermentation processes developed at the Northern Regional Research Laboratory, the commercial production of penicillin has been undertaken by 17 chemical and pharmaceutical manufacturers, and plants estimated to cost \$15,000,000 are now being constructed. With the completion during the next few months of this additional plant capacity, production is expected to increase to about 35 billion units per week, whereas present production is a few million units per week.

Owing to its contributions and leadership in developing the fermentation processes, assay techniques and procedures for isolating and purifying the drug; the Northern Regional Research Laboratory has become the center for consultation and instruction on the production of penicillin. One of the Laboratory leaders in this work has been selected by the Office of Scientific Research and Development to assist in the coordination of the penicillin production program in this country and abroad.

This new drug, which has been so successfully used in the treatment of war wounds and civilian infections which have resisted other medical treatments, has been called the outstanding medical development of the present war. It is considered so valuable to the armed forces that virtually all production has been requisitioned for Army and Navy use.

Alcohol from wheat: During the past year, increased demands for alcohol, accompanied by dwindling supplies of corn and restricted importation of molasses, made it imperative that wheat be used as a raw material for the production of alcohol. Because of operating difficulties encountered, many distillers were reluctant to change from corn to wheat. At the request of the War Production Board, an Industrial Conference was held at the Northern Regional Research Laboratory in November, 1942, at which time we were asked to conduct research on certain phases of the problem and to coordinate the cooperative program which was then formulated. The experimental results of all collaborators were compiled by the Laboratory, and were disclosed at a second conference which was held in February, 1943. A final conference held in October, 1943, discussed problems connected with the utilization of protein feed from wheat alcohol and summarized all research results obtained to date. As a result of these cooperative efforts, the main operating difficulties have been overcome and wheat has been accepted by the industry as a suitable raw material for the production of alcohol. Wheat used for alcohol production during the fiscal year 1943 amounted to about 54 million bushels.

Utilization of Damaged Wheats: Practically all types of damaged wheats have been processed for starch, and many types have been tested for alcohol production. The quality of starch produced ranges from good to excellent, and the yield of alcohol parallels starch content. Wheat of sample grade or unfit for food or feed can therefore be utilized for starch or alcohol production, the starch being suitable for use as adhesives or for such industrial purposes as making foundry core binders. About 20 million bushels of damaged wheat are estimated to be now available in the United States. Utilization of this wheat by industry offers a logical means of conserving our dwindling food and feed resources.

Production of 2,3-Butylene Glycol and Butadiene: This process development initiated by the Laboratory has been mainly in pilot plant stage during the past year, supplemented by necessary laboratory control and investigational studies. Three steps are involved in the process: (a) Fermentation of wheat, corn, granular wheat or starch to 2,3-butyleneglycol; (b) recovery of the butyleneglycol; and (c) conversion of the butyleneglycol to butadiene.

It is conservatively believed that 12.5 pounds of the butyleneglycol can be obtained by fermentation per bushel of corn or wheat and that 14 pounds can be obtained from starch. Yields approaching 14 pounds per bushel of corn or wheat have been obtained and the pilot plant studies on fermentation are concerned with methods of controlling the operation to attain these higher yields.

The recovery step uses a combination of evaporators, drum driers and a distillation column from which there is obtained almost pure 2,3-butyleneglycol and dry concentrate of the remainder of the stillage residue. This concentrate is high in proteins. It has been demonstrated on a small pilot plant scale that this process is technically and mechanically sound, and full-scale pilot plant operations are in progress to determine final over-all recovery yields. Most conservative figures indicate 92 percent recovery and better than 95 percent recovery is believed possible.

The third step, involving the conversion of butyleneglycol to butadiene by the formation of the diacetate and the cracking of this chemical at high temperatures, has been studied by means of a pilot plant designed and built at the Laboratory, which is capable of producing 100 pounds of butadiene per day. This work has been completed and a full report has been submitted to the Office of Rubber Director. This work shows that butyleneglycol is converted 85.4 percent to a butadiene of the purity of 98.5-99 percent with a recovery of 99 percent of the acetic acid in process. Small amounts of salable byproducts are obtained.

The report contains process, equipment and operating data necessary for the design of a large-scale plant. This part of the process requires special equipment, while the recovery process and the fermentation process use equipment of standard design, well known in the fermentation

industry. It is believed possible at this time to undertake the design of a full-scale plant since the entire engineering details, except the exact capacities of certain equipment used in the fermentation and recovery steps, are available to design engineers.

Assuming what is believed to be conservative yield figures; namely, 12.5 pounds of butylene glycol per bushel and a 92 percent recovery, a bushel of corn or wheat will produce 5.9 pounds of butadiene. With 13 pounds of glycol per bushel and a 95 percent recovery, 6.3 pounds of butadiene will be obtained per bushel of wheat or corn. As a comparison figure, the alcohol process now in operation is producing from 5.25 to 5.5 pounds of butadiene per bushel of corn.

Starch From Wheat: Two new processes have been developed in the Northern Regional Research Laboratory for the production of starch from wheat. In one of these processes, whole wheat is the raw material and starch is produced in the same equipment as that used in the wet-milling of corn. In the other process, wheat flour is used and the process itself is adaptable to beet sugar plants. In either case, very little new equipment is required to carry out these processes on an industrial scale. The starch produced by the wet-milling process is of excellent quality and can be used to replace corn starch. Either process will produce starch suitable for conversion to glucose sirups. In both processes, gluten can be recovered for use as a high protein feed, while in the flour process it is sufficiently pure for use in glutamic acid production.

A conference on the milling of wheat and small grains was called, at the request of industry, in May 1943, at the Northern Regional Research Laboratory. Forty-nine persons, representing 28 organizations, from the corn wet-milling industry, wheat millers, beet sugar refiners, starch consumers and the War Production Board were present. The details of both wheat starch processes were disclosed at this meeting. As a result of information developed at this conference, the methods presented are now being studied intensively on a pilot plant scale at the Northern Regional Research Laboratory and in the laboratories of several interested industrial concerns. Among these is a West Coast concern which will utilize the process for the production of glucose sirups for the bakery trade and for fermentation to industrial alcohol in the wineries. A beet sugar plant in Michigan is now utilizing this process and producing one million pounds of glucose sugar monthly. The method discovered for recovering wheat gluten is now being used by a rice starch manufacturer and a producer of sirup from wheat flour to retrieve protein formerly discarded. Most of the byproduct, gluten, will be made available to industrial producers of glutamic acid, or used as a feed. In view of the shortage of starch, sweetening agents and high protein feeds, the two new methods now being developed for producing starch from wheat are particularly timely.

Zein (Corn Protein): Research on the Extraction and the preparation of stable solutions of zein and its use as a raw material for plastics is being continued. Progress effected in this work will aid

in the extended use of zein when surplus zein is available. Certain phases of this work, such as the stabilization of zein with formaldehyde and its plasticization with water and soluble chemicals, have been reported to industry. Further new utilization of zein awaits a greater production capacity since the War Production Board has placed the current output of zein on strict allocation for war use.

Soybean and Other Oilseed Crops Utilization Investigations: The war has resulted in an unprecedented demand for vegetable oils both for food and for industrial use. To meet this demand, oilseed production has been greatly expanded. Although there are certain elemental differences in the oil and protein of the various oilseeds, these differences are not sufficient to prevent their interchangeability in many of the uses to which vegetable and animal oils, fats and proteins are put. This interchangeability in use is facilitated in many instances by chemical or processing modifications evolved through research. Oils are used for food, for lubricants and in the manufacture of soap, paint, varnishes, linoleum, printer's ink, metal castings and plating, textiles, leather goods, glycerine, explosives, synthetic fibers, hydraulic fluids, molded products, rubber substitutes, etc. In peacetime, their uses form an important part of our life, and in war many of them are grim necessities.

Of the oilseeds with which this Laboratory is concerned; namely, soybeans, flaxseed, sunflower seed, safflower seed, rapeseed, perilla seed, hempseed and castor beans, only the first two are at present produced in the United States in quantities large enough to have any industrial significance. The others, or the oil therefrom, are imported for domestic consumption, as their production in the United States has not proved sufficiently profitable to reach substantial proportions.

While the war lasts, utilization studies on vegetable oilseeds are of vital importance in increasing production of old products to meet expanded requirements and in developing needed substitutes and new products. After the war, further utilization studies will be of importance in aiding the shift to a workable peacetime economy. The development of new and improved uses for the oil, protein and meal fractions from oilseeds is the subject of intensified research at the Laboratory. The following items are cited as typical examples in this field.

Norepol: This rubber substitute obtained from soybean oil, attained an estimated production of 1,500,000 pounds in 1943. This amount was far short of the goal estimated by the War Production Board in January, which included the use of soybean Norepol as water-proof coatings. This single use would have called for approximately 12,000,000 pounds of Norepol. Production was limited because of a world shortage in vegetable oils which forced the allocation of soybean oil and restricted its use for Norepol. The work on Norepol is now completed except for the search for possible substitutes for soybean oil as a raw material.

Super-Norepol: Superior resistance of Norepol to ozone and aging indicated that, if improved, the product could find a much wider usage. Laboratory experiments, in which pure intermediates were used, have now obtained a Super-Norepol which, in certain respects, resembles some of the synthetic rubbers. Laboratory methods for obtaining these intermediates in a pure form are too costly to be used on a large scale unless warranted by unexpected developments in the synthetic rubber program. Commercial production awaits the development of new or the improvement of old methods for obtaining these pure intermediates. Research on this phase has achieved some progress, but it has not been successful enough to suggest immediate application on an industrial scale for rubber.

Norelac: Norelac is a thermoplastic resinous material which is obtained from soybean oil. Laboratory and pilot plant work has demonstrated the feasibility of its commercial production and some possible wartime use for which it was particularly adapted. The most important of these uses appears to be in packaging, where it may be used as a heat-sealing, moisture-proofing and laminating agent for the packaging of foods, chemicals and other materials, such as machine parts. One company has estimated that they could use 10,000 pounds per month as a minimum in the packaging of items essential to the war effort and the civilian front.

Soybean Protein: A new extraction method has led to the improvement in color and flavor of soybean protein. This improved flavor has attracted attention since soybean flour is being used to supplement our own food supplies as well as that of our allies. By request of the Food Distribution Administration and in connection with the Soy Food Research Council, this method is being investigated further. The nutritional value of soybean protein has long been recognized, but its flavor has limited its acceptance. Improvement of the flavor of soybean flour will aid materially in meeting our food requirements since large quantities of soybean protein can be made available.

Southern Regional Research Laboratory

Project Statement

Project	1943	1944 :(estimated):	1945 :(estimated):
1. Cotton utilization investigations	\$ 748,943	\$ 815,000	\$ 816,300
2. Sweetpotato utilization investigations	127,019	142,800	143,000
3. Peanut utilization investigations	55,563	61,200	61,300
Covered into Treasury in accordance with Public Law 674	1,200	- -	- -
Unobligated balance	22,525	- -	- -
Total available	955,250	1,019,000	1,020,600
Transfer from "Conservation and use of agricultural land resources"	-960,750	- -	- -
Transfer to "Salaries and expenses, library"	+ 5,500	- -	- -
Anticipated deficiency for overtime pay	- -	- 65,605	- -
Total estimate or appropriation	- -	953,395	1,020,600

Examples of Progress and Current Program:

Cotton Utilization Investigations:

Use of Cotton for Tire Cord: Since November 1942, research on cotton tire cord has been given principal attention in the Laboratory's work on cotton lint. The undertaking of this research coincided with installation at the Laboratory of textile equipment for manufacturing yarns and cords, and with receipt of information that the Army had recently found tires made with rayon cord superior for certain classes of service to those made with standard commercial cotton cords. Activity under this project is divided into two main types: (a) Experimental selection of the best available varieties of cotton for use in making tire cord by modern commercial processes, followed by the manufacture of this cord into tires for test by the Army, and (b) fundamental and applied research to develop improved types of cotton tire cord by chemical and mechanical treatment and by changes in the physical construction of cotton tire cord. The Army has expressed its willingness to test tires with experimental cords that may be developed which appear to be better than those now available.

In the experimental selection of the best varieties of cotton to use for tire cord, five bales each of the five outstanding varieties of cotton, which are available in commercial quantities large enough to be of interest to the cotton tire cord industry, were purchased for manufacture into tire cord for test tires. The selection of these varieties was based on the results of many years study of breeding, yield tests, fiber studies and spinning tests carried on jointly by the Bureau of Plant Industry, Soils and Agricultural Engineering and Marketing Service, Food Distribution Administration. These five varieties are: Stoneville 2-B, Acala 1517, Delfos 651, Wilds 13 and SxP. ;

Cotton cord fabrics for test ties have been manufactured as follows. (a) by the Thomaston Cotton Mills: one lot of fabric from each of "the five varieties," twisted into cord and woven into fabric from yarns spun at the Southern Regional Laboratory; (b) by the Bibb Manufacturing Company; one lot of fabric from each of "the five varieties," spun, twisted and woven into fabric from cotton furnished by the Southern Regional Laboratory; (c) one lot of fabric from Wilds 13 cotton spun, twisted into cord and treated by the Southern Regional Laboratory according to a modification of one of Nickerson's processes, and woven into fabric by the Thomaston Cotton Mills. All fabrics were delivered during May and June to the Armstrong Tire and Rubber Company, which company is making the test tires.

On the basis of Armstrong's usual laboratory tests, the Thomaston SxP, Wilds and Stoneville fabrics were selected for the manufacture of an initial lot of S-4 test tires (90 percent Buna, 10 percent natural rubber). Sixty-one tires have now been manufactured as follows:

Tires Available for Road Tests

Variety Cotton	Military Non-Directional and Snow Tread	Standard Uniform Directional and Snow Tread
SxP	12	6
Wilds 13	14	7
Stoneville 2-B	15	7

An official directive has been issued for the Army to test the tires with military treads. It is not planned to make up test tires from any of the other lots of cotton fabrics until the performance of these tires in Army road tests has been determined. Opportunity will thereby be provided for making any changes in the construction of subsequent test tires which may be indicated as desirable from the results of these road tests.

In addition to these sixty-one test tires, two tires have been made up from the fabric of each of these three varieties for indoor wheel tests and analysis by Armstrong. Such tests have already been made on the SxP tires. The penetration test for carcass rupture resistance gave a value of 8,400 pounds, a value ranging high in comparison with other cotton tires of the same size. On the smooth indoor wheel test, the SxP tire ran 7,045 miles before failure due to a heat blow-out in the region of a thread crack first observed about 1,000 miles earlier. The load on this tire had by this time been increased to 135 percent of the rated load of the tire. This performance was on a par with that shown by similar rayon tires and was considered by Armstrong to be an indication that the SxP tires will give good service on a smooth road test. Similar data are now being obtained on tires made from the other two fabrics.

In connection with research to develop improved types of cotton tire cord, a machine for treating, stretching and drying cords on a semi-plant scale has been designed and built. This machine was used to produce the Wilds 13 cotton cord, mentioned above, for Army test tires. A smaller machine, similar to this one for handling only a single cord, has been built for making small experimental lots of cord for laboratory tests. A third machine has been built for continuously acetylating, washing and drying yarn for making experimental cord.

Flex-fatigue life is an important factor in tire cords. Two new types of flex testing machines have been designed and built at the Southern Regional Laboratory. Under an arrangement with one of the large tire manufacturers, test samples are being regularly interchanged for the purpose of correlating and interpreting the results of flex tests.

Proper adhesion between cord fabric and rubber stock (synthetic and various compounds, etc.) is of importance not only during service but also during the manufacture of tires. Considerable difficulty is experienced in obtaining proper adhesion with stock containing a high percentage of Buna. A preliminary survey has been made of laboratory methods used in measuring adhesion and equipment is now being built to measure the adhesion of individual cords to rubber stock at both room and elevated temperatures. The problem is being attacked from two main directions, (a) to develop adhesive compounds which will bond the rubber stock to cotton itself (that is, "specific" adhesion), and (b) to develop methods and compounds by which the cord and yarn structure can be impregnated with rubber stock, or with a substance which will impregnate the cord and bond itself to the rubber stock. Preliminary experiments have shown that a very good impregnation can be obtained with goldenrod rubber in an emulsion produced from a benzene solution, using a cationic wetting agent. These experiments are being followed up in an attempt to impregnate the

cord with goldenrod rubber containing a vulcanizing compound. Some of the cord experimentally produced in the Southern Regional Laboratory by various chemical and mechanical treatments appears to be superior to available commercial cords on the basis of laboratory tests. Attention is now being given to the problem of producing such cords on standard tire cord equipment, or with the least possible modification.

A number of fireproofing treatments stable to washing have been tested. The most promising of these involves the use of an emulsion containing antimony oxide, chlorinated paraffin and a urea-formaldehyde resin. The cloth is fireproof and only moderately changed in physical characteristics. It may be laundered up to 10 times. The process is being evaluated and further developed for military and industrial uses.

Cut Lint Cotton for Smokeless Powder: In order to assure our country an ample supply of linter-type alpha-cellulose for smokeless powder, should crop failure or other unavoidable circumstances interfere with the supply of cotton linters, Southern Regional Research Laboratory engineers have developed a special machine to cut cotton lint to the length of linters. This fiscal year witnessed the successful completion of an experimental (4") model disc-type cotton cutter and a high-capacity cleaner-feeder unit. Extensive tests proved the cutter very efficient, and that even this small experimental model had a production capacity more than 25 percent greater than the largest standard types of commercial cutting machines, with operation costs less than half as great. Patent applications have been made on these developments.

The War Production Board and the War Department were vitally interested in securing the construction of a large machine, and at their request, a special Congressional appropriation of \$30,000 was obtained to finance its manufacture. A 16-inch machine was deemed adequate in size for commercial use at linter purification plants, and a contract has been let to build this equipment. It is estimated six months will be required to complete the job. The Government of one of the principal Allied countries has also requested plans and specifications for one of these machines for use in connection with a proposed powder plant in that country.

Aside from its war importance, the cutter and feeder have a large number of possibilities for post-war use in agricultural and other fields. For example, with certain modifications, a cutter of this type might be used to replace hammer mills and ball mills in oil-processing operations; for shredding citrus fruits or leaves in obtaining essential oils; for shredding wood chips prior to steam extraction; and for cutting various types of silage. The principal of the cleaner-feeder might

also be adapted to high-speed feeding and cleaning in cotton textile mill processes.

Rubberless Cotton Fire Hose: An examination of available synthetic plastics and elastomers as possible substitutes for rubber hose lining has indicated that a fairly satisfactory type of cotton jacketed fire hose can be prepared by employing as lining material one or more of the so-called synthetic rubbers such as Thiokol, Norepol and Butyl rubber. A process has also been developed for treating cotton yarns which imparts to fabric woven from the treated yarn swelling and waterstop properties equal to those of the linen hose which is ordinarily used in making unlined emergency fire hose.

Preservation of Sandbag and Camouflage Fabrics (in collaboration with the Naval Stores Research Division of the Bureau and with other Department agencies): The extensive investigation of preservative treatments for sandbag fabrics undertaken in 1940 at the request of the Corps of Engineers, War Department, is being continued in cooperation with the Corps of Engineers, the Quartermaster Corps, the United States Bureau of Standards and a Federal Specification Subcommittee. During the past fiscal year, this research has been broadened to include work on mildew, rotting and weather resistance of other types of treated Army fabrics. Many hundreds of samples of commercially proofed fabrics have been tested for the Corps of Engineers and detailed examinations made of different proofing materials, including a survey to set up an efficient classification of the more important commercial types. Special attention has been given to the development of testing methods for mildew and rotproofing treatments and the study and improvement of the soil burial tests as a means of evaluating such treatments is being continued, since reliance continues to be placed on this acceleration of the aging test as a method for rapid evaluation of treated fabrics. A new preservative process was developed for impregnating cotton material such as osnaburg for sandbags with furfuryl alcohol and then forming a resin from it by means of various organic acids. The resin forms not only on the surface but also in the cell walls and lumen of the fiber, thus protecting it against the action of microorganisms. By soil burial test, this treatment has been demonstrated to be more effective than those processes now specified by the War Department. The process is being applied to larger quantities of fabric in an effort to adapt it to commercial operation with a minimum of alteration of existing chemical finishing equipment.

Improvement of the Stability of Nitrocellulose: A new stabilization treatment for nitrocellulose has been developed which requires much less time and fuel than the usual hot water stabilization process. The effect of this treatment on other properties of the nitrocellulose does not appear to be deleterious as far as it is known.

Cotton Bale Patterns: A shortage in the supplies of jute and jute fabrics normally imported for cotton bale covering has made it necessary to increase sharply the production of cotton fabrics for this purpose. A complicating feature of the problem is the fact that the type of cotton fabric used in past years is made from very coarse yarns, the production of which cannot be increased sufficiently for manufacturing the required quantities of fabrics. To obviate this difficulty, technologists of the Laboratory designed an alternative type of fabric made with finer yarns which can be obtained in considerable quantities. Sample fabrics for testing were produced with the cooperation of the Land Cotton Mills of New Orleans, and on the basis of these tests, specifications have been set up and issued for use in a program to obtain a total of 8,000,000 cotton bale patterns for handling the 1943 crop.

Binder Twine: Development work on an all-cotton binder twine was continued for part of the year, using special additive and modifying treatments to produce a stiffer cotton twine, but this phase of the work was dropped when the War Production Board raised sharply its estimates of binder twine shortages, and when an industry survey showed that available manufacturing capacity for this type of all-cotton binder twine was adequate to provide only a small fraction of the estimated shortages. Personnel and equipment were shifted to the testing of many different types of commercial experimental binder twines for the War Production Board. These experimental twines included sisal and cotton combinations, sisal and paper combinations, all paper twines, palmetto tow and sisal mixtures and various similar combinations with henequen. Tying tests were performed with a binder head furnished through the courtesy of the International Harvester Company. From the results of laboratory tests and field tests, an emergency binder twine program was evolved using a cotton core in sisal twine. This core comprises about 30 percent of the weight of the twine and thus spreads the limited amount of sisal into a larger supply of twine. The cotton program is subsidized through Government agencies to use low-grade cotton stocks held by the Government. The cotton core is composed of yarns of a type available in adequate quantities and the twine itself is being made on existing hard fiber equipment.

Cottonseed Investigations: Work has continued on the development of substitutes for imported fats and oils. Further industrial tests have been made of the palm oil replacement previously described. It has been demonstrated that this product, a modified cottonseed oil, is actually superior to palm oil for use in production of tin andterne plate. Under normal conditions, the cottonseed oil replacement would cost twice as much as palm oil, but its useful life would be 3 times as long. The feasibility of replacing the entire present annual consumption of 40 million pounds of imported palm oil with modified cottonseed oil has been demonstrated. A modified cottonseed oil suitable as a replacement for imported cocoa butter,

used extensively in confectionery and pharmaceutical products, has been produced. The process used consisted of a combination of controlled hydrogenation and low temperature solvent fractionation of the saturated fats. The development of suitable commercial processing equipment should make possible the use of cottonseed oil for the more than 50 million pounds annually imported for use in the confectionery and pharmaceutical industries.

Since the announcement of this development in May 1943, numerous inquiries have been received regarding the availability of this new product and for information on the type of equipment necessary to produce it. A commercial equipment manufacturer has stated that the design and construction of large-scale equipment will be undertaken in the near future.

It has been demonstrated on a laboratory scale, using this low-temperature solvent and fractionation process, that the time of winterization of cottonseed oil can be reduced from 4 to 6 days to 5 to 6 hours. The winterized oil appears to be equal or superior to the present commercial product.

Continued success has attended the investigations to prevent the deterioration of stored moist cottonseed by the use of ammonia. A pilot plant scale experiment with 1 ton of cottonseed has indicated that the method is applicable to large lots of seed. It is planned to apply this method to full mill-scale operation during the 1943 crushing season and, if practicable under these conditions, its general introduction should follow, which would result in a considerable reduction in the loss of oil which annually occurs as a result of deterioration of cottonseed stored in moist condition.

A survey of the needs for palm, cocoa and similar oils of Pacific origin, and the possibilities of obtaining replacement oils from Latin America was made and reported to various war agencies.

Work on the stability of hydrogenated and unhydrogenated cottonseed oil has led to a considerable advancement in our knowledge and ability to stabilize fats, particularly against oxidative rancidity both from the standpoint of the addition of synthetic antioxidation and in the control and preservation of the natural antioxidant, which is present in the original fat or oil. Improvements in the apparatus and methods employed in determining the stability of fats and oils and of the methods of determining the amount of natural antioxidant, which is present in a given fat or oil, have made possible better control of the processing factors involved in the production of fat and oil products having improved keeping quality.

In an effort to increase vegetable oil supplies by improving the technology of extraction, a complete 8-cell extraction battery pilot plant, with all necessary and auxiliary equipment, has been installed and operated. Continuous operation for periods of 4 to 5 days has established the feasibility of the extraction battery arrangement and process for recovering oil from cottonseed cake. A sufficiently high recovery of the available oil has indicated that operation on a large scale is economically feasible. Optimum operating conditions in cycles have been determined and details of design and construction of the equipment have been checked to provide all data necessary for design and installation of efficient commercial-scale plants. A commercial producer of vegetable oils has inquired concerning the feasibility of the process. The pilot plant can be operated whenever this is necessary, in order to demonstrate the equipment constructed.

A large number of adhesives have been prepared from cottonseed protein. Complete evaluation has not been possible because of lack of equipment. However, adhesives have been tested which possess appreciable higher dry and wet shear strengths than are required to meet the Army and Navy specifications for water-resistant casein glue.

Sweetpotato Utilization Investigations:

Sweetpotato Starch: Continued efforts have been directed at investigations relating to the manufacture and use of sweetpotato starch, to aid in offsetting the shortage of root starches by increased and improved production of sweetpotato starch. At the same time, increased emphasis has been placed upon other sweetpotato products and their utilization, with the objective of providing additional sources of food, feed and industrial materials and of converting present wastes into useful products.

With the Laurel Starch Plant of Sweet Potato Growers, Incorporated, still the only source of sweetpotato starch in the United States, it was imperative that the research program provide for continuation of all possible technical aid to this enterprise in utilization of its facilities for production of high quality starch to the limit of its capacity. At the same time, an increasing fund of information and experience was made available for full technical advice and assistance to other enterprises in a position to undertake production of sweetpotato starch.

In experiments at the Laurel Plant, a simplified, low-cost system of concentrating and purifying starch by continuous settling was found to permit handling a materially higher quantity of starch with smaller volume capacity than the settling procedure now employed, with reduced losses and a cleaner product. Such a process would greatly facilitate successful design and operation of small sweetpotato starch plants without the need for costly, large-scale equipment difficult or impossible to obtain under conditions such as prevail during the present emergency.

The large-scale starch blending equipment installed in 1941, and the system for its control permitted uninterrupted blending and bagging of the plant output, ready for shipment, in 12-20 tons batches. The increased efficiency of plant operation and the economy of labor were conspicuous. Further improvements were made in the dust collection system to eliminate remaining hazards.

Simple and reliable methods for improved control of starch bleaching were developed and applied on a plant scale, with resultant economy of chemicals and improved quality and uniformity of the finished starch. Improvements were made in methods and procedures for chemical control of other processing operations and of the quality of the products.

The starch produced by the Laurel Plant in 1942 was of high quality and uniformity. Most of it was sold as produced and went into specialized uses where sweetpotato starch has proved to be superior to other starches for products urgently needed in the war effort. Among such applications were manufacture of dry batteries and electrical insulating cloth. There was a demand for many times the total output for the foregoing and other specialized uses.

For 1943, the impetus to sweetpotato production afforded by the emergency dehydration enterprise of Sweet Potato Growers, Incorporated, and the seasonal conditions to date favor a raw material supply adequate for a plant capacity output of starch. Technical advice and assistance have been intensified to aid the plant in attaining a maximum production of sweetpotato starch. At the same time advice and assistance have been broadened to aid in technical aspects of design and operations of the new dehydration plant and integration of its operations with those of starch manufacture. Construction of a large plant for the production of sweetpotato starch and other sweetpotato products is going forward.

A short, but full-scale, plant run was made with the new L-5 high-starch variety of sweetpotato which will comprise a considerable proportion of the crop in the Laurel area for 1943. With minor adjustments in operating conditions, these sweetpotatoes will process as well, and probably better, than the Triumph hitherto grown for starch; higher yield and quality of starch are indicated. Small-scale pilot plant trials with other special or new varieties indicated that a number of high-starch varieties, newly developed or now in limited production, offer advantages over either the Triumph or L-5 in yield and quality of starch and in ease of processing.

Examination of the "latex" of sweetpotatoes indicated that the content of rubber-like material is too low to be of practical importance.

Recovery of Food and Feeds From Starch Processing Wastes: A process for recovery and conversion to feed of most of the sweetpotato protein now wasted in starch manufacture has been developed to pilot plant scale.

On a laboratory scale, high-grade pectin, comparable to citrus pectin in quality, has been extracted from sweetpotato pulp in yields equivalent to as much as 40 pounds per ton of fresh sweetpotatoes. Recovery of pectin in connection with the present process of sweetpotato starch manufacture is complicated by the use of lime. However, the trim and cull wastes from sweetpotato canning and dehydration plants afford a new source of pectin for food, pharmaceutical and industrial uses.

Processes for production of feed yeast on the carbohydrate wastes from sweetpotato starch manufacture or from sweetpotato canning and dehydration plants have been brought successfully to a pilot plant scale, and they could be carried to commercial scale with relatively simple and inexpensive equipment. There is afforded a profitable outlet for byproducts now entirely wasted in the manufacture of sweetpotato starch and in the canning and dehydration of sweetpotatoes, as well as a new source of a valuable protein and vitamin-rich feed supplement.

Peanut Utilization Investigations: As a worsted lubricant in the textile industry, a replacement from peanut oil has been developed for imported olive oil. This product, obtained by a combination of controlled hydrogenation and low-temperature solvent fractionation process (see Cottonseed Investigations) has been tested commercially and reported to be superior to olive oil. This solvent fractionation process has also made possible the winterization of peanut oil, an operation which heretofore could not be performed. Yields are similar to those obtained with cottonseed oil. Extension of this laboratory-scale processing operation to commercial scale would permit the interchangeability of peanut oil with other oils, particularly corn and cottonseed oils in salad dressings and mayonnaises.

In the effort to increase the stability and reduce the spoilage of edible oils, the natural anti-oxidants of peanut oil have been examined. Concentrates of the anti-oxidants were obtained and assayed with respect to their alpha tocopherol content and their activity in stabilizing various fractions of distilled oils.

Improvements have been made in the apparatus and methods employed in determining the stability of fats and oils and the methods of determining the amount of natural anti-oxidant which is present in a given fat or oil, and has made possible better control of processing factors involved in the production of fat and oil products having improved keeping qualities.

In the effort to increase the industrial utilization of peanut protein in the war program, the determination of physical and chemical properties of the introgenous constituents of peanut meal has been continued. A Spectrophotometric method has been developed whereby the suitability of the color of protein preparation derived from various commercial peanut meals can be simply and rapidly estimated. The Georgia Agricultural Experiment Stations are cooperating in making available special varieties of peanuts having white skins, which eliminates many of the color problems in producing commercial protein products from peanuts.

The pigment contained in the red-skinned varieties introduces a contaminant which ordinarily must be removed. Methods have been developed on a laboratory scale for the production of purified protein fractions of various types of peanut meals. This work can be translated to pilot plant operations as soon as adequate equipment can be obtained and installed. A large number of peanut protein adhesives have been prepared and tested. Adhesives have been obtained which possess appreciably higher dry and wet shear strengths than required to meet Army and Navy specifications for water-resistant casein glue.

Synthetic protein fibers have been obtained from peanut protein. The first attempt to spin a peanut protein dispersion was successful with the resultant fiber quite low in tensile strength. In succeeding experiments, the strength has been progressively increased and the color of the fiber has been considerably improved. The results of the spinning operations to date indicate that a satisfactory fiber can ultimately be produced from peanut protein, but many variables must be investigated and proper control of the spinning operations must be determined and applied before industrially acceptable fiber is produced.

Eastern Regional Research Laboratory

Project Statement

Project	1943	1944 (estimated)	1945 (estimated)
1. Apple utilization investigations a/	\$75,951	\$113,800	\$113,900
2. Vegetable utilization investigations a/	34,229	47,600	47,700
3. Tobacco utilization investigations	170,939	205,400	205,600
4. Milk products utilization investigations	242,607	274,000	274,100
5. Animal fats and oils utilization investigations	192,027	215,400	215,500
6. Potato utilization investigations a/	111,965	85,000	85,000
7. Tanning materials, hides, skins and leather utilization investigations a/	58,769	73,400	73,500
Covered into Treasury in accordance with Public Law 674	1,200	- -	- -
Unobligated balance	67,563	- -	- -
Total available	955,250	1,014,600	1,015,300
Transfer from "Conservation and use of agricultural land resources"	-960,750	- -	- -
Transfer to "Salaries and expenses, library"	+ 5,500	- -	- -
Anticipated deficiency for over-time	- -	- 61,205	- -
Total estimate or appropriation:	- -	953,395	1,015,300

a/ Joint project with Western Regional Research Laboratory.

Examples of Progress and Current Program:

Apple utilization investigations: A year ago it was reported that a process for the production of a bland apple sirup from apple juice had been developed. It was indicated that this high levulose sirup might find a number of potentially important industrial outlets because of its moisture-retaining and other properties. Information regarding the process and product was promptly called to the attention of apple processors and other interested industrial organizations.

In view of the impending curtailment of glycerine supplies for use in tobacco products, representatives of the tobacco industry met at

the Eastern Regional Research Laboratory in May of 1942 to discuss possible GLYCERINE SUBSTITUTES. The tobacco industry is one of the largest peacetime consumers of glycerine, normally using over 30 million pounds. Among other products, apple sirup was suggested as a likely substitute and large samples were supplied for tests which pronounced it satisfactory. Firm orders resulted and about three million pounds of apple sirup were produced from the 1942 apple crop by five processors. Varied industrial interest in the product has mounted steadily and one of the large cigarette companies has featured in its advertising the use of the sirup as a humectant in its cigarettes. The availability of a satisfactory glycerine replacement is of considerable importance, not only to the tobacco industry but to the apple industry. It provides an extensive outlet for vinegar-grade fruit which has sold at very low prices for several years. Production of sirup from the 1943 apple crop is estimated at 20,000,000 pounds by fifteen different processors. Among new uses which have shown promise are in pharmaceutical sirups, cosmetics, dentifrices and fruit ices; tests also indicate it is a satisfactory extender for glycerine in the cork industry. Some of these uses indicate an advantage for apple sirup which would assure its peacetime success.

The research work on the problem has been intensified and is continuing along the following lines: (a) Eliminating certain difficulties involved in commercial sirup manufacture, (b) development of new uses other than as a tobacco humectant, and (c) development of modified forms of the sirup which will widen the market and provide additional outlets for apple products.

Vegetable Utilization Investigations: Previous studies have shown that many vegetable waste materials, particularly the leafy portions, are relatively rich in carotene (provitamin A) and riboflavin (vitamin G). Because the war has created shortages of these essential dietary substances, investigations were focused on development of methods of recovering them from waste vegetables.

With the lowered production of fish liver oils and the increased demand for vitamin A, carotene concentrates can play an increasingly important role in national nutrition. Many vegetable leaf wastes are so high in carotene that an economical process of recovery appears possible. Therefore, the extraction of CAROTENE FROM DRIED VEGETABLE WASTES has been studied intensively and large scale laboratory procedures have been worked out to such an extent that pilot plant studies can now be undertaken.

Further investigations have disclosed that dried vegetable wastes are possible large scale sources of protein, carotene, and riboflavin for use in animal feeds. In view of the shortage of high protein feedstuffs for increased production of dairy and poultry products, emphasis has been shifted to utilization of vegetable wastes to meet the needs for high protein feedstuffs, particularly

for the poultry and dairy industries. Drying of these vegetable wastes has been successfully carried out without significant loss of nutritive elements. The relatively high content of nutritive substances contained in the leaf blades indicates that their separation from the stems is worth the extra step involved, and a method of separation of the leaf blade fractions by rotary mill screening of the partially dried wastes has been devised. Extensive storage tests have been made to determine carotene losses in dried vegetable wastes at room temperature, and at 40° F. In general, carotene losses are negligible under storage for three months at 40° F., whereas they are considerable after one month storage at room temperature. After five months' storage 40 percent of the carotene is the average retention for vegetable wastes at room temperature, and 67 percent at 40° F. Preliminary arrangements have been made for conducting cooperatively with the Delaware State Experiment Station large scale feeding tests with certain of the dried vegetable wastes in order to fully evaluate the materials from the standpoint of feeding value.

Tobacco Utilization Investigations: The vital importance of maximum food production has further emphasized the need for NEW AND IMPROVED INSECTICIDES, particularly in view of current shortages of imported contact insecticidal materials. Nicotine, because of its unique properties as a contact poison, stomach poison and fumigant, serves an important role in insect control without which food production would suffer serious losses. Nicotine also serves as the preferred raw material for the manufacture of nicotinamide (anti-pellagra vitamin). Current research, therefore, is directed to the development and testing of new forms of fixed nicotine compounds, new and improved compounds for use as activators of nicotine, nicotine carriers and the further development of methods for the production of nicotinic acid and nicotinamide from nicotine.

In connection with studies on preparation of new nicotine compounds for use as insecticides, a number of additional nicotine-metal double salts have been prepared. Many of the double salt compounds have now received preliminary testing against insects and some five or six appear to have notable toxicity. These include certain copper and zinc combinations which may be suited to commercial production. A new type of nicotine-metal compound -- the nicotinammino type -- has now been made. Compounds of this type are prepared by the use of free alkaloid reacting with certain metal salts. A number of them show unexpected stability and desirable physical properties and their preparation is simpler than that of the double salts. Tests of their insecticidal action are now in progress in cooperation with the Bureau of Entomology and Plant Quarantine. In cooperation with other Government agencies, a formula has been developed for dusts against pea aphids which calls for a reduction in rotenone content from 1.0 to 0.5 percent with the addition of 2.0 percent of nicotine alkaloid and 10 to 20 percent of sulphur. This formula and similar ones with slight variations, involving the

conservation of imported rotenone-containing dusts, have given satisfactory control in field tests.

Two new processes have been developed for the oxidation of nicotine to nicotinic acid. Study of the catalytic liquid phase oxidation of nicotine to nicotinic acid has resulted in yields of 75 percent of theoretical. Various catalysts and combinations of catalysts did not produce yields higher than 75 percent. The catalytic vapor-phase oxidation of nicotine results in the formation of a partial oxidation intermediate, nicotinonitrile, in slightly over 50 percent yield. The intermediate product can be converted by hydrolysis to either nicotinamide or nicotinic acid. Extensive studies on the hydrolysis of nicotinonitrile by various agents have led to the discovery of an entirely new method for the preparation of the PELLEGRA PREVENTIVE VITAMIN, NICOTINAMIDE.

In connection with the recovery of valuable byproducts from waste tobacco or from residues left in the manufacture of nicotine, rutin, a glucoside occurring in tobacco, has been isolated in a state of purity. It was thought that rutin might have a vitamin P activity, and arrangements were made for testing it under clinical conditions. After six months' trial, it appears that rutin has merit in the treatment of diseased conditions associated with capillary fragility. Reports of tests indicate that in many cases it will prevent conditions which lead to apoplexy and blindness resulting from either cerebral or retinal hemorrhages due to high blood pressure. As a precaution, the effect of long continued feeding of rutin to laboratory animals was studied in cooperation with the Bureau of Animal Industry. Rutin was found to be harmless to the animals used. Further studies on improving the method of preparation as well as more extensive clinical tests are being undertaken.

Milk Products Utilization Investigations: Research on milk products is being conducted along lines that should yield practicable results in the development of methods of producing strategic materials and vital replacements in the present war program. Principal efforts are directed towards (a) development of suitable bristle substitutes from casein, (b) production of protein fiber that can be extensively employed as a substitute for wool, (c) improving the characteristics of protein plastics to make possible their substitution for other plastics and metals required for vital war needs, (d) recovery of casein from skim milk on farms, and recovery and utilization of whey proteins, and (e) production and development of critical materials such as resins, synthetic rubbers, plastics and related materials.

In view of the serious shortage of natural bristles required for the production of many types of brushes in wartime economy, work was initiated and has been intensively prosecuted on the development of suitable BRISTLE SUBSTITUTES FROM CASEIN. Some of the best product was made into sample brushes including a counter brush, a hair brush and paint brushes. The fiber and the brushes have been examined by representatives of the War Production Board and Technical Subcommittee.

Federal Specifications on Brooms and Brushes. It was the consensus that the casein bristles were probably suitable for the construction of certain types of dry brushes such as counter and textile brushes for which materials are scarce. In the meantime, further work and tests are being continued on the development of casein bristles for paint brushes. In regard to use in paint brushes, an important characteristic of casein bristle is its inertness toward organic solvents. This is also a property of natural pig bristles but not of all synthetic bristles.

Work on PROTEIN TEXTILE FIBER has been actively pursued particularly in securing appraisals and setting up proper methods of appraisal of the casein fiber as compared with wool. With the cooperation of the Philadelphia Textile School, casein fiber staple has been converted to yarn and the yarn woven into several yards of 100 percent cloth. Breaking strength, thermal transmission and abrasion tests, together with dyeing experiments, have been performed on the cloth. Wet and dry tensile strengths, elongation and resistance to boiling water have been determined on the fiber. The results show that casein fiber in some respects is inferior to wool, although some of the differences are not particularly important and certain characteristics of casein fiber may be actually superior. The most serious problem to be solved is the relatively low resistance to the effect of water.

The goal of the program on PROTEIN PLASTICS has been to develop a molding powder which could be converted in a single operation to the finished product -- as opposed to the conventional methods now being employed. Progress has been slow but definite advances have nevertheless been made. A first requirement is that the molding material possess a suitable flow within practical limits of temperature and pressure employed in the molding process. Casein, prehardened with formaldehyde and then plasticized with 10 to 25 percent water, does not fuse completely in the mold. The discs tend to be somewhat inhomogeneous, brittle and susceptible to checking. Some derivatives of casein, such as casein treated with sodium sulfide, have given better flow but no better plasticizer than water has been found for these products. Attractive results have been secured with casein subjected to acylating and esterifying operations. One product gave test discs with a water content, after immersion in water for 72 hours, of only 12 percent as compared with 24 percent for casein prehardened with formaldehyde.

Because of the large demand for plastics and synthetic rubber products brought about by the war, special emphasis is being placed on the preparation of synthetic rubber, plastic intermediates and rubber compounding materials from lactic acid, which can be prepared by fermentation of the lactose in whey. A continuous low cost method for producing methyl acrylate from lactic acid has been developed, and numerous lactic and acrylic esters have been prepared. Various types of PLASTIC AND SYNTHETIC RUBBER INTERMEDIATES have been prepared from the acrylic esters. Some of the

polymers obtained have been combined with fillers, plasticizers and accelerators, and vulcanized; it was found that certain of the cured products have high tensile strength (over 1,800 pounds) and an elongation of 300 to 500 percent. Various colors consisting of organic dyes and pigments have been incorporated in these polymers. Water emulsions of these compounds have been prepared which can be brushed, spread or sprayed. The results obtained in this work indicate that an extensive chemical industry can be based on the conversion of annually reproducible low-cost carbohydrates into lactic acid and its derivatives. The polymers can be mechanically combined with other substances for use as plastics or synthetic rubbers. The organic solutions can be used as coating and impregnating compounds and as adhesives. The emulsions have advantages over many other materials in that they are low cost, cause no health or fire hazards and can be applied easily to dry or wet surfaces. They dry quickly and produce a film that is resistant to both fresh and salt water. Tests show that these emulsions can be used advantageously to coat plaster and concrete, especially for oil and gasoline storage tanks or barges.

Animal Fats and Oils Utilization Investigations: Critical shortages of foods brought about by the unprecedented demands of the war have stressed the utter necessity for improved means of preserving foods subject to spoilage. This problem is especially acute for animal fats and oils in view of the general shortage of fats and the comparatively poor keeping qualities of animal fats, particularly lard. Lard and the animal fats are readily susceptible to oxidation changes known as rancidity and the prevention or retardation of these changes is of considerable economic and strategic importance. Principal emphasis in current research is therefore being placed on an early practical solution of this problem.

A year ago it was reported that two new series of fat-soluble antioxidants, mono fatty acid esters of l-ascorbic and d-isoascorbic acids, had been synthesized and preliminary accelerated aging tests indicated some promise. Further laboratory scale work on the preparation of the new compounds has revealed conditions which indicate the need for pilot plant scale work to adapt the process to commercial manufacture. Considerable industrial interest has been manifested.

Investigations on the use of fatty acid monoesters of l-ascorbic and d-isoascorbic acids as ANTIOXIDANTS FOR FATS AND OILS indicate that the effectiveness of the ascorbyl esters is dependent chiefly upon their synergistic activity with other inhibitors such as phospholipids, tocopherols and other phenolic compounds present in the fat or oil.

An effective and practical antioxidant combination is obtained when ascorbyl esters, soya lecithin and tocopherols are employed in the proportion of 0.03, and 0.005 percent respectively. When

added to lard in these concentrations, the stability is increased about 6-fold, and when twice these amounts are used, about 10-fold stability is obtained. This ternary antioxidant combination was found to be effective for a variety of fats and oils including oleo oil, tallow, various types of lard, butter oil, oleomargarine and common vegetable oils. In fact, the vegetable oils such as corn, cottonseed, soybean and wheat germ, serve as direct sources for tocopherol for the ternary antioxidant combination. Thus, 0.06 percent ascorbyl esters, 0.06 percent soya lecithin and 5 to 10 percent of one of these vegetable oils added to lard give a product having a stability of about 50 hours. These results were based on the Swift stability test at 100° C.

The tests to determine practical applicability are progressing. Stability tests on fats containing the ternary composition were made at lower temperatures. Oven tests at 50° C. showed roughly the same relative order of antioxidant effect compared to the controls as obtained by the Swift test at 100° C., although the tendency was toward lower protection.

Storage tests at 21° C. are in progress. Preliminary results indicate that a definite antioxidant effect is obtained by using the synergistic antioxidant combinations.

Baking tests on crackers containing lard stabilized with the antioxidants were favorable. The stabilizing effect carried through the baking process as shown by stability tests on the crackers.

Tests to determine whether the ascorbyl esters are nontoxic are under way in the Food and Drug Administration.

Steam deodorization does not affect the stabilizing action of the antioxidant combination adversely. In some instances, this process increased the antioxidant effect, possibly by removing volatile prooxidants from the lard. Steam deodorization of lard containing the ascorbyl esters and soya lecithin causes some discolorization which can be removed by treatment with activated carbon or Fuller's earth either during deodorization or subsequently. This decolorizing treatment lessens the stability of the product appreciably. However, even after deodorization and decolorization, a bland white product having a stability of 40 to 50 hours (Swift test) is usually obtained.

Potato Utilization Investigations: In connection with studies on the preparation, properties and utilization of derivatives of potato starch, a number of significant results have been obtained. A starch derivative has been prepared which, when compounded with pigments, sulphur and accelerator with subsequent vulcanization, gave a product having a smooth surface with high gloss and resembling hard rubber in many respects. It is insoluble in all common organic solvents, resistant to oil at 100° C. and is not attacked

by dilute acids or alkalis. It appears that this derivative is suitable for use as a surface material for veneer panels, table tops and similar objects, particularly where resistance to organic solvents is required. More extensive investigations of methods of preparation, properties and uses of this compound are being carried out.

Three methods of preparing starch acetate were developed: (a) the treatment of ordinary potato starch with various mixtures of acetic acid, acetic anhydride and catalyst; (b) the pretreatment of starch with various concentrations of formic acid followed by esterification with acetic anhydride; and (c) the treatment of starch suspended in an organic solvent, such as acetic acid, with ketene. Best results were obtained by the second method, in that an excellent quality of starch ester with high degree of esterification can be readily prepared in a short time. However, results indicate that perfection of the ketene method would permit the production of high quality esters at lower cost, which would result in widening its field of application.

The results from these developments indicate that starch esters and ethers can be made readily and that they will have utility as SUBSTITUTES OR EXTENDERS FOR SOME OF THE CRITICAL MATERIALS used in plastic compositions, adhesives and lacquers for protective coatings and impregnating solutions for fibrous materials.

Tanning Materials, Hides, Skins and Leather Utilization Investigations: Because of the increased demand for leather resulting from war needs, and the cutting off of a considerable part of our importations of tanning materials, research has been directed chiefly to (a) development of increased supplies of DOMESTIC VEGETABLE TANNING MATERIALS; (b) conservation of chrome supplies by the development of new tannages and improvement of leather for Army and Navy use; and (c) increasing leather supplies by conservation and improvement of hides and skins and development of unused domestic supplies.

Western hemlock bark represents one of the largest undeveloped domestic sources of tannin. Difficulties encountered in utilizing hemlock bark are loss of tannin when logs are floated to the mills, and contamination of bark with salt if logs are floated in sea water. Tannin liquors prepared by leaching (a) woods-peeled, (b) salt water-floated, and (c) fresh water-floated hemlock barks were concentrated to approximately 60° barkometer (= 1.06 sp.gr.). After suitable dilution, these liquors were used for tanning cowhide into heavy leather. Tanning progressed normally with liquors from woods-peeled, cured bark, but penetration was about one-third slower in liquors from both the floated barks. The tannins from floated barks are more astringent than those from woods-peeled barks, and because of this difference in character may require different blending procedures than are normally used for hemlock. The leathers tanned with floated bark tannin were darker in color and did not bleach as successfully as those made with woods-peeled bark tannin.

This may be due to the fact that the floated barks had not been aged. Methods for elimination of salt from hemlock bark liquors were studied, and a method has been devised for the preparation of hemlock extract from salt-water-floated bark. Pilot plant scale preparation of hemlock bark extract has been carried out on the West Coast in cooperation with the Western Regional Research Laboratory in order that large scale tanning experiments can be made in a commercial tannery.

Work on the development of canaigre and sumac as domestic sources of tannin has made definite progress as a part of the cooperative program with the Bureau of Plant Industry, Soils and Agricultural Engineering and the Soil Conservation Service. The 1942 canaigre crops from experimental plantings at Lubbock and Winter Haven, Texas, and State College, New Mexico, have been harvested, yields recorded and replantings made. The crop at State College yielded over 10,000 pounds of roots. As a result of progeny studies, one strain of canaigre which possesses particularly desirable characteristics as regards size and shape of roots, yields and tannin content has been selected for expanded propagation. Roots yields in the 1942 crops showed marked improvement over those obtained in 1941. To serve as a basis for the selection of high tannin clones for propagation and the location of strains suitable for large-scale collection, and to acquire information concerning the tannin contents of sumacs from different localities, a large number of samples from Maryland, Virginia, Georgia, Florida, North Carolina, Arizona, California and Iowa were analyzed for tannin content. Work is in progress this year to produce sufficient domestic sumac in Iowa to furnish materials for test runs on the manufacture of sumac extract.

Results of further studies show that improved properties are imparted to vegetable leathers by retanning with alum. The results obtained point to the definite possibility of utilizing alum retannage of vegetable leather as a means of replacing chrome in the event that an acute shortage of this war material should develop. The durability of alum-retanned vegetable leathers is also being demonstrated in book-binding leathers. Three commercial leathers—two vegetable-tanned followed by alum retannage, and one vegetable-tanned followed by chrome retannage—have shown satisfactory resistance to accelerated aging by exposure in a gas chamber. These leathers are being used in experimental bindings by the Government Printing Office. Durability in actual service will be compared with results obtained by accelerated aging. Looking toward the development of tannages utilizing domestically produced tannins to replace imported materials no longer available because of war conditions, experimental tanning tests have been conducted using finely ground canaigre roots. Canaigre-tanned pickled calf retanned in alum and chrome-tanned pickled calf retanned with canaigre have received favorable comment by a commercial tanner.

Western Regional Research Laboratory

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):
1. Apple utilization investigations (a)	\$ 59,525	\$ 79,100	\$ 79,200
2. Alfalfa utilization investigations	39,832	26,700	26,700
3. Fruit utilization investigations	260,805	232,200	232,400
4. Potato utilization investigations (a)	27,512	59,600	59,700
5. Poultry utilization investigations	165,389	154,000	154,200
6. Vegetable utilization investigations (a)	229,179	382,500	382,900
7. Wheat utilization investigations (b)	79,966	75,700	75,800
8. Tanning materials - western hemlock bark as an emergency source (a)	10,407	22,300	22,300
Covered into Treasury in accordance with Public Law 674	1,200	- -	- -
Unobligated balance	81,435	- -	- -
Total available	955,250	1,032,100	1,033,200
Transferred from "Conservation and use of agricultural land resources"	- 960,750	- -	- -
Transferred to "Salaries and expenses, library"	+ 5,500	- -	- -
Anticipated deficiency for overtime pay	- -	- 78,705	- -
Total estimate or appropriation	- -	953,395	1,033,200

(a) Joint project with Eastern Regional Research Laboratory.

(b) Joint project with Northern Regional Research Laboratory.

Examples of Progress and Current Program:

Apple utilization investigations: A wartime need for increased amounts of feed having a high nutritive value in proteins and vitamins has required studies on the production of yeasts. Laboratory scale experiments simulating commercial operations have shown that the carbohydrates in apple (and also other fruit) wastes may be converted by yeasts into valuable protein feeds containing notable quantities of the "B" vitamins. Such feed is especially useful as a supplement in poultry rations. The shortage of protein feeds and the "B" vitamins for poultry feeding may soon become critical. The process under investigation enables the utilization of apple (or fruit) wastes as protein and vitamin sources in those areas where both apple (or fruit) and poultry production are major industries. Cooperative investigations on a pilot plant scale for the production of such a yeast at a local commercial yeast manufacturing plant have indicated that it is an industrially feasible process. In this particular instance the juice from cull dried prunes is the medium being investigated. The process is equally suitable for use on apple wastes.

The development of a WASHABLE OINTMENT BASE in which pectin is used as an emulsifying agent was completed. A wide variety of medicaments are compatible with this base and samples of it containing sulfathiazole have been submitted to ten leading pharmaceutical manufacturers for their consideration.

Progress has been made in the study of PECTIN AS A SUBSTITUTE FOR BLOOD PLASMA. It has been difficult to obtain pectin from apples and apple wastes so that it is free from poisonous spray residues to use it in a blood plasma substitute. It has been demonstrated that a pectin free from lead and arsenic can be readily and economically prepared by means of synthetic ion exchangers. This same method of removing spray residues may make it possible to utilize apple wastes such as peeling, cores, etc., in the preparation of the apple syrup developed as a glycerine substitute by the Eastern Regional Research Laboratory for use in tobacco conditioning and for other purposes.

With the demand for pectin exceeding the supply many preservers and apple processors are interested in the possibility of manufacturing an APPLE PECTIN CONCENTRATE from dried apple pomace. Research was carried out to obtain information of a specific nature on the various phases of the process. This information is being made available to interested parties through the medium of an information release.

Improvements have been made in the technique of spray drying apples for subsequent use in jams, jellies, baking goods, beverages, dessert mixtures, etc. A pilot plant spray drier capable of producing larger quantities of the dried product has been designed and is under construction. Information gained in the construction and operation of this spray drier is expected to be extremely useful in developing plans for commercial equipment that will be used by industry in preparing apples and other fruits in the spray dried form.

Preliminary studies have been made on the compression of "apple nuggets" (ordinary dried apples cut into small pieces and further dehydrated to a low moisture content). The indications are that entirely satisfactory compressed blocks of high density can be made by processes which give promise of being commercially practical.

Alfalfa utilization investigations: Alfalfa is one of the most promising sources of carotene (provitamin A) concentrates, furnishing an almost unlimited reserve. The 0.4 pound of carotene in a ton of dry alfalfa hay has a value of \$106.00 and is sufficient for the provitamin A needs of 100,000 people for one day for the prevention of "night-blindness" and other nutritional deficiencies. The United States and Great Britain have been severely affected by the loss of imports of fish liver oils which resulted from the occupation of Norway. In addition, our own fishing industries have been curtailed as a result of the war, and supplies of vitamin A are becoming increasingly critical. Carotene enters the trade as a substitute for vitamin A. Lend-Lease shipments and the increasing domestic needs for carotene are making the product more difficult to obtain.

Recent advances in the problem of CAROTENE PRODUCTION AND PRESERVATION include the following:

A continuation of studies on antioxidants for the stabilization of carotene has shown that alpha tocopherol (vitamin E) compares favorably with other stabilizers such as diphenylamine which were previously found useful. Vitamin E has the advantage of being better suited for use in preserving the carotene in food or feed products.

A chromatographic method of analysis for carotene in vegetable oils has been developed using aluminum oxide as the absorbent. This method enables analyses to be performed in less than 1/5 of the time formerly required. It is useful as a research technique and will be very valuable in making regulatory checks on the strength of commercial preparations. Further information has been obtained on the extraction of carotene from alfalfa meal by various solvents particularly with a

view to their availability, cost, recovery and their suitability for recovering other valuable byproducts such as chlorophyll as a vegetable coloring material, and at the same time retaining a much needed high protein cattle and poultry feed from the extracted residue.

It has been shown that alfalfa meal retains its vitamin content much better when protected from atmospheric oxygen. In order to accomplish this on a commercial scale, fruit storage rooms or other tightly enclosed spaces may be utilized with cheap combustion gases for a protective atmosphere. One of the important values in alfalfa meal as a feed stuff for poultry and livestock is due to its carotene content. Also, alfalfa meal thus stored would be suitable for year around use in the extraction of carotene, thus avoiding the need for large processing plants which could operate only during a short season.

Fruit utilization investigations: Fruit-growing is a widely distributed and highly diversified farm activity with a total gross farm value of at least 500 million dollars, of which about 50 percent is produced in the Western Region. Improved methods of preserving this important food so that it all can be saved and fully utilized are especially important in wartime. As one means of accomplishing this result, spray-drying studies have been made. This technique has had only minor application in the field of drying fruit juices or purees. The greatest single difficulty encountered has been the formation of a sticky mass, clogging the equipment, instead of an easily handled powder. In searching for drying aids to facilitate the SPRAY DRYING OF FRUIT PRODUCTS, it has been found that the addition of small amounts of certain substances such as methyl cellulose, pectin derivatives, etc., are especially effective. As little as one-half of one percent of the dry weight of the fruit product is sufficient in some cases to produce satisfactory powders. The entire problem of producing vitamin-rich, palatable fruit powders is being actively investigated because of the wartime demand for concentrated fruit products for use by our armed forces and friends across the seas. During the past year approximately 150 runs have been made in a laboratory spray drier and about two dozen in commercial spray driers. Boysenberries, strawberries, grapes, grapefruit and oranges were among the materials successfully spray dried in the laboratory. Many of the products exhibit excellent retention of ascorbic acid (vitamin C), carotene (provitamin A), color and flavor through the dehydration operation. The small commercial sized (pilot plant) spray drier now under construction will be used in a continuation of this work to determine commercial feasibility of the processes and to produce powders in sufficient quantity to make adequate storage and utilization studies.

Pilot plant drying experiments in the piece form as distinguished from spray drying have been conducted on some of the small fruits, particularly raspberries. Acceptable, though not necessarily what ultimately may prove the best, recommendations can now be offered for the small fruits that have been investigated.

War with Japan stopped the importation of agar and as a result we are facing a critical shortage of that material. Agar is used as a culture media in all hospitals and research laboratories studying bacteriology. The serious consequences of an agar shortage to routine hospital tests and to medical research are readily apparent. A mixed metallic salt of fibrous pectic acid derived from citrus fruits or apples has been developed with properties similar to those of agar. This product has been under cooperative test at the University of California and in other laboratories where a large number of different kinds of bacteria have been satisfactorily grown on it. This new product can serve as an adequate SUBSTITUTE FOR AGAR in many uses, thus largely protecting our war effort from serious difficulties caused by a shortage of this critical material.

Further work has been conducted on using pectin derivatives to replace imported water soluble gums formerly obtained from the Mediterranean countries in amounts approximating 24 million pounds annually. Improvements in the methods for preparing these gum replacements have been notable during the past year, making pectin a much more satisfactory material for such diverse uses as stabilizing and emulsifying agent in food products such as mayonnaise and pharmaceutical preparations.

Two types of low-methoxy pectin derivatives have been developed. One has important potentialities as an ingredient of textile fireproofing materials widely used in wartime, while the other has proved to be a useful and versatile product in the preparation of low sugar gels (important in sugar conservation) and other food products.

A new and improved method of pectin extraction using sodium hexametaphosphate was discovered. This method has the advantage of producing higher yields more quickly than the present commercial process and for that reason appears susceptible to treatment as a continuous process and without increased plant layout.

In cooperation with the Bear Creek Vineyard Association, Lodi, California, a pilot plant for the recovery of tartaric acid by means of ion exchangers was designed, built and successfully operated during the fall harvest season of 1942. Laboratory studies since that time

have resulted in improvements both technically and from the financial viewpoint. It is expected that further runs at Lodi, California, this fall will demonstrate the commercial feasibility of a process for recovering our entire national needs of tartrates from winery waste materials. The importance of this development can be more readily visualized when it is realized that we formerly imported substantially our entire needs of this essential material from the wine-producing countries of Europe.

A critical shortage in organic plasticizers for some of the major industrial resins was the motive for developing such materials from domestically available fatty acids. A number of very promising compounds have been furnished to industrial concerns for further testing and evaluation.

As a result of war restrictions on metal containers for processed foods and at the urgent requests of the industry, the Western Regional Research Laboratory has successfully developed techniques for freezing such items as cranberry sauce, tomato products, pork and beans, and for many fruits formerly canned in number 10 cans for industrial food manufacture such as pie-baking and preserve-making. Commercial production of these items based on formulas and procedure developed here is now under way.

It has been demonstrated that ripe apricots, figs, peaches, pears, plums and prunes for use in jams, preserves and baby food can be frozen as they come from the orchard and held in sub-zero storage without color or flavor changes for many months before further preparation or processing. This permits the labor and equipment requirements for processing to be spread over the entire year instead of during a short harvest season.

Two formulae have been developed and tested commercially for supplementing the diminishing supply of ice cream with fruit puree. It has been shown that a frozen dessert with the smooth texture of ice cream can be prepared from puree obtained from fully ripe fruit regardless of its size and shape, thus utilizing fruit which might not otherwise be marketable.

The office of the Quartermaster General has followed with interest the development of a number of these new frozen products and has requested the Bureau to continue investigations on them with a view toward adapting them for use at military posts in this country.

Potato utilization investigations: White potatoes, with an average yearly production of about 375 million bushels, comprise the largest vegetable crop in the United States. They are an extremely important dietary item and large quantities of dehydrated potatoes are being shipped to our armed forces and to our Allies. For that reason DEHYDRATION has become a highly important commercial process and although dehydrated potatoes are being accepted in large quantities for army and Lend-Lease use, there are still many unsolved problems concerning the best techniques of processing to obtain a high quality product with minimum loss of food value, manpower, and strategic materials. Production of a dehydrated potato which will retain satisfactory quality under high temperature storage conditions is yet to be achieved. Compression of the dried potato into dense bricks which may be reconstituted to a satisfactory product has not yet proved wholly successful. Laboratory and pilot plant tests in peeling of root crops by immersion in heated liquids or solutions of various salts have demonstrated that potatoes can be successfully and economically peeled by these methods. The use of hot brine in some instances has been shown to be superior to lye peeling in that it is safer, more economical, and less likely to cause discoloration. Peeling losses are considerably lower than those encountered in abrasion peeling, which is the most widely used commercial procedure. This improvement in peeling alone will conserve large supplies of needed food material. During the past year nearly 100 separate pilot plant runs have been made on potatoes, each involving the operations of washing, peeling, trimming, cutting in pieces, blanching, and traying before placing in the dehydrator. Particular attention has been paid to vitamin retention through all stages of the processing operations and storage.

Comparisons have been made between sliced, cubed, stripped, and diced potatoes to determine relative loss of soluble materials in the blanching and washing stages, and ascorbic acid and general quality during the whole process. Methods have been devised for measuring the completeness of rehydration by determining drained weights of the soaked or cooked products. This is important in evaluating the effect of various processing and storage conditions on the product quality.

Measurements of the rate of transfer of heat through dehydrated potatoes (and other vegetables) have shown that they are poor conductors of heat. These data provide a basis for calculating the time required for dehydrated potatoes which have been packaged while hot to cool to safe storage temperatures. The measurements also show that dehydrated potatoes and also other vegetables can possibly be used successfully as thermal insulation for large scale shipments of frozen meat without a refrigeration system.

A number of improved dehydrator designs have been prepared and released to interested commercial operators. Recommended processing procedures in white potato dehydration have been made available to the public in the form of an information sheet (AIC-9) and much specific and detailed information has been furnished interested persons by correspondence or interview. Potatoes received considerable attention at the dehydration training conferences described under "Vegetable Utilization Investigations."

Cooperation in our dehydration work has been maintained with the Quartermaster Corps of the Army, War Production Board, Food Distribution Administration, the British Food Mission, Officials of other Allied Nations, and investigators along related lines in colleges, experiment stations, and private industry.

Poultry utilization investigations: Government purchases of dehydrated whole egg during the fiscal year starting July 1, 1943 are estimated at 450 million pounds. This quantity is equivalent to more than one billion dozen shell eggs. A large proportion of the total amount will be sent to allied populations through Lend-Lease channels and to our armed forces overseas. Because of the long shipping route it is essential that a product be prepared which retains the high protective and nutritive value of fresh eggs up to the time of actual consumption. Research has been directed toward means of PRESERVING THE VITAMIN CONTENT OF EGGS during dehydration and subsequent storage. There seem to be two distinct problems involved. One is the prevention of chemical changes responsible for the development of bad odors and a loss in palatability. The second is the prevention of changes responsible for destruction of vitamin A. Emulsified whole eggs can be and probably are normally dehydrated without loss of nutritional quality. Prolonged periods of storage, even under favorable conditions, result in marked loss of vitamin A and thiamin. Work completed thus far shows that the tocopherols preserve vitamin A better than any other anti-oxidant studied. Marked increase in the retention of vitamin A is obtained when this material is incorporated with the eggs before spray drying. Compression of the egg powders results in a decreased rate of vitamin destruction during storage. The combined effect of anti-oxidants and compression needs further investigation with relation to its application as a commercial process. It is contemplated that work along these lines will be actively followed during the coming year.

About 800,000 tons of liquid eggs will be dehydrated this year. Approximately 12,000 tons ($1\frac{1}{2}$ percent of egg white will adhere to the shells

with most of it being discarded as waste. The laboratory has been engaged in two kinds of studies directed toward the utilization of this waste egg white. First, it has been found that lysozyme, which is useful as BACTERIACIDE, may be recovered. The method devised is relatively simple, inexpensive, and permits the recovery of lysozyme from waste egg whites without destroying the egg white for other industrial uses. Second, egg white has been one of the most promising materials used in studies on the PRODUCTION OF ARTIFICIAL FIBERS. At the present time the interest in artificial protein fibers at this laboratory is being directed toward their production for surgical sutures. Wartime needs for surgical sutures may not be met by the present supply of gut and silk fibers. Two of the larger surgical supply houses have expressed a definite interest in this development and arrangements are being made for the practical testing of experimental sutures produced at this laboratory. Other materials that may be used in the production of an artificial protein fiber include feathers, hoofs, hog bristles, other animal hair, and wheat proteins.

The keratin proteins, which include those derived from feathers, hair, hoofs, horn, etc., have been investigated with relation to their use as an ingredient in plastics and glues. Developments during the past year have indicated that while they are not at the present time suitable for use alone, they may be useful as an extender both for phenolic resins and glues. In this manner they will help to conserve short supplies of both resins and glue for essential war uses.

Vegetable utilization investigations: In normal times over three million acres are devoted to growing vegetable crops having an annual farm value of about 275 million dollars. Wartime demands have appreciably increased this volume of vegetable production.

When the desirability of using frozen vegetables in army camps in the United States was recognized by military authorities, a request was issued by the Office of the Quartermaster General to the Western Laboratory to determine the feasibility of fitting frozen vegetables into the procurement and distribution system prevailing in the larger army posts. Laboratory work showed that the 40 degree F. storage available in company mess halls would safely protect frozen vegetables for six days or longer. These findings were corroborated by actual use tests in army camps where it was shown that the vegetables could be routinely handled and required no more special care than any other perishable product. On the strength of these tests the army decided to purchase 75 million pounds of frozen vegetables during the fiscal

year starting July 1, 1943. This accomplishment for the army is highly significant in their food procurement program, as has been testified to by high army personnel. The more frozen foods that can be used by the army in this country, the more foods preserved in other ways are released for shipment abroad.

Excellent FROZEN FOOD PRODUCTS have been developed as a result of wartime demands from cull or sort-out foodstuffs hitherto wasted. These new products include chopped broccoli, purees of various vegetables and fruits, and steamed boned poultry from old birds. The vegetable products are made from stalks, butts, or leaves, the fruits from distorted, scarred, or soft but otherwise wholesome specimens. By changing the form of such raw material, new uses and new foods have been made possible and an entirely new method for utilizing waste and cull foodstuffs in frozen form has been developed.

At the request of the War Department and in cooperation with the Food Distribution Administration work was continued on grade standards for use in the large scale purchase of frozen foods.

The estimated Government purchase of DEHYDRATED VEGETABLES, exclusive of white potatoes and soup mixtures, will be approximately 260 million pounds during the fiscal year commencing July 1, 1943. This amount is equivalent to well over a million tons of the fresh vegetables. Several hundred new dehydration plants will come into operation this summer and fall, many of them in sections of the United States which have never before dehydrated any foods, and in many cases they will be without experienced personnel. A large amount of information has been developed at the Western Laboratory during the past year, which should materially assist in enabling dehydrator operators to produce a better product.

Studies have been made upon the influence of the state of maturity or dehydration characteristics and quality of the dried products. During the past year more than 450 separate pilot plant runs have been made, each involving most of the operations of washing, peeling, trimming, coring, cutting in pieces, blanching, and traying before placing in the dehydrator.

Studies have been made on various kinds of PACKAGES AND PACKAGING MATERIAL FOR DEHYDRATED VEGETABLES. Packaging is an important problem, when it is realized that the low moisture content of these dehydrated foods causes them to collect dampness from the air, which markedly accelerates the loss of vitamins and palatability.

Experiments have been made on the reduction of bulk in dehydrated vegetables by compression. Recently increased interest has been expressed in this subject by military authorities, and it is planned to devote an increased amount of work to this phase of dehydration investigations.

Studies on the design of dehydrators and vegetable preparation equipment have been continued with many innovations and improvements suggested. The information developed has been made available to those interested by means of information sheets, blueprints, and personal interviews. A dehydration manual has been prepared, summarizing the work thus far completed. This manual is now in press and should be available for distribution soon. In addition, three large conferences or dehydration schools were conducted, largely by staff members of the Western Regional Research Laboratory and cooperating State experiment stations. The first dehydration training school was held at the Western Regional Research Laboratory in September 1942. It was attended by over a hundred practical commercial operators. A similar conference was held in October at Rochester, New York for eastern processors. A third school was held this spring at the Western Regional Research Laboratory for the benefit of State experiment station personnel in order to enable them better to assist dehydrators in their respective States.

Cooperation on our dehydration work has been maintained with the Quartermaster Corps of the Army, War Production Board, Food Distribution Administration, the British Food Mission, officials of other Allied Nations, and investigators along related lines in colleges, experiment stations, and private industry.

Many reports have appeared during the year concerning the commercial usefulness of microbiologically produced ANTIBACTERIAL AGENTS. These materials give promise of being valuable new tools for the treatment of wounds and other infections. Tyrothricin is one of two such agents which has been given extensive medical evaluation studies and seems most promising. The agent has not yet been placed on the open market due to difficulties associated with production. At present it seems that the factor limiting production is lack of information necessary to secure in marketable quantities. Our own contribution of improving yields and reducing batch failures by growing the tyrothricin-producing organism upon supplementary asparagus waste juice may be important factors in making commercial production possible.

Modification of long chain saturated fatty acids to yield derivatives whose alkali soaps simulate coconut oil soaps has been the subject of an investigation. Dehydrochlorination of dichlorinated palmitic acid by pyrolysis has yielded products the sodium soaps of which have excellent lathering qualities.

Wheat utilization investigations: Crude ergot from which the ergot alkaloids are prepared for medicinal use is not now readily available. The country in the past has relied upon importations from sources which are at present restricted or unapproachable for our transportation facilities. We are informed that even after the present difficulties of transportation are removed it is not reasonable to expect that ergot products will be available on the American market at prices comparable to those that existed during the pre-war period. It is very desirable that a new source of supply of this essential drug be developed if it is to remain available to medical practitioners on a cost basis comparable to that which has existed heretofore. The cultural requirements of the ergot-producing fungus have been determined so that abundant growth may now readily be obtained on wheat media. It has been found that cultures or strains of the fungus differ markedly from each other in many of their properties. Some of these "strains" are now being investigated with the hope of finding one or more which will produce medicinally useful alkaloids when grown under laboratory conditions.

Methods for the preparation of glutamic acid and sodium glutamate from wheat gluten have been investigated. A new method for the analytical determination of glutamic acid in proteins has been developed. This has been made available to industry and considerable active interest in it has been shown. Sodium Glutamate, with a flavor resembling beef stock, is very useful for making dehydrated vegetable soup mixtures and other foods tasty and palatable. A new method for the separation of glutamic acid from other amino acids by resinous ion exchange agents has been developed. This gives promise of having considerable industrial importance.

Wheat gluten reacts with chlorosulphonic acid to produce GLUTEN SULPHATE. This material, in a dry powdered form, has the remarkable property of absorbing and holding bound in a stiff jell approximately 200 times its own weight of water. If the preliminary results obtained with gluten sulphate by several physicians are further confirmed, it seems quite possible that this material will prove of considerable value in treating wounds; especially those which have become infected.

As indicated under "Poultry Utilization Investigations," fiber development work at this laboratory is mainly directed at the present time toward the production of satisfactory surgical sutures. Wheat gluten mixed with egg albumen forms one of the more promising protein mixtures for this purpose.

Western hemlock bark utilization investigations: Tanning materials are essential to the production of leather, which in turn is an essential commodity in the prosecution of the war as well as a peacetime necessity. At the present time the United States now relies upon foreign sources for approximately 65 per cent of its vegetable tanning materials. It is, therefore, of vital importance that this country develop additional sources of tanning materials to meet emergency requirements.

A project on "Tanning Materials, Hides, Skins and Leather Utilization Investigations" has been assigned to the Eastern Regional Research Laboratory of the Bureau of Agricultural and Industrial Chemistry. The objective of that project is "to develop new and extended uses for hides and skins through establishment of means for the most profitable and efficient production and utilization of agricultural leather-making raw materials." The present emergency has developed a situation wherein the present uses and outlets for hides and skins is endangered through possible shortage of tanning materials necessary for the conversion of these byproducts of agriculture to leather. It has been shown that the most likely source of immediate replacements for our present-day imported tanning materials is the bark of the western hemlock.

The object of the project assigned to the Western Regional Research Laboratory is to both supplement and complement the objective of the "Tanning Materials, Hides, Skins and Leather Utilization Investigations" project of the Eastern Regional Research Laboratory by maintaining the present uses and outlets for hides and skins through the development of equipment, processes, and procedures for the recovery from the bark of the western hemlock of a tanning material which will assist in relieving any emergency that may result from the shortage of this critical material.

A pilot plant scale EXTRACTION OF TANNIN from hydraulically peeled, salt-water-floated, western hemlock bark was conducted with a commercial tannin extraction plant. It was demonstrated that sea water salt could be largely removed by means of a preliminary cold water leach. In order to prepare an amount of tannin sufficient

for experimental leather tanning tests which are to be conducted by the Eastern Regional Research Laboratory, approximately 200 tons of bark were leached. The extraction procedure followed that used in previous pilot plant experiments and sufficient tannin extract has been prepared for the experimental leather tanning tests.

Laboratory investigations are being continued on various problems that concern the preparation of a satisfactory tannin extract from western hemlock bark.

General Administrative Expenses

PROJECT STATEMENT

Project	1943	1944 :(estimated):	1945 :(estimated):
1. Central administration	\$106,831	\$132,340	\$132,500
Covered into Treasury in accordance with Public Law 674	590	- -	- -
Unobligated balance	12,379	- -	- -
Total available	119,800	132,340	132,500
Transfer.. from "Conservation and use of agricultural land resources"	-157,000	- -	- -
Transfer to:			
"Salaries and expenses, Office of Administrator, Agricultural Research Administration"	+ 24,895	+ 24,895	- -
"Salaries and expenses, Office of Secretary of Agriculture"	+ 4,000	- -	- -
"Salaries and expenses, Office of Solicitor"	+ 2,800	- -	- -
"Salaries and expenses, Office of Information"	+ 1,700	- -	- -
"Salaries and expenses, library"	+ 3,805	- -	- -
Anticipated deficiency for overtime pay	- -	-11,430	- -
Total estimate or appropriation :	- -	145,805	132,500

This project provides for the administrative supervision and direction of the work of the four regional research laboratories. Its objects are (a) to develop a well coordinated research program for the laboratories, (b) to maintain proper control in order to avoid duplication of research activities, and (c) to maintain in Washington centralized control and direction of the business activities necessary for the proper functioning of the organization as a whole, including personnel, budget, book-keeping, auditing, purchase and property, editorial and information, files, etc.

The general administrative staff has conducted the administrative operations dealing with the development of a well-coordinated research program for the four research laboratories and has exercised the necessary business service control. Necessary assistance and administrative supervision was given to the laboratories in the consideration and purchase of supplies, equipment and services, maintenance of personnel, editing of manuscripts and other administrative services.

Frequent conferences have been held with the Directors of the laboratories in order to maintain a well-coordinated, forward-looking research program. For the latter purpose, meetings of the Agricultural Experiment Station Relations Committee have been held at each laboratory, and necessary contacts have been maintained with the Office of the Agricultural Research Administrator and other agencies.

Research and administrative supervision was given to three Argentine chemists who spent portions of the year at each laboratory under a training program financed by a working fund established with this Bureau by the Office of the Coordinator of Inter-American Affairs.

(g) Special Research Fund, Department of Agriculture
(Allotment to Bureau of Agricultural and Industrial Chemistry)

This budget schedule covers obligations under an allotment for special agricultural chemical researches of a fundamental nature.

(h) Emergency Rubber Project, Department of Agriculture
(Allotment to Bureau of Agricultural and Industrial Chemistry)

This budget schedule covers obligations under an allotment for investigations to develop new or improved processing methods for the manufacture of rubber from domestic rubber-bearing plants, including rabbitbrush, guayule, *Cryptostegia*, Kok-saghyz (Russian dandelion) and goldenrod.

(i) Removal and Reestablishment of Arlington Farm, Virginia
(Transfer to Agriculture)
(Allotment to Bureau of Agricultural and Industrial Chemistry)

This budget schedule covers past obligations under an allotment for the removal and reestablishment of functions and activities at Arlington Farm, including plans and specifications, acquisition of land, erection of buildings, equipment, etc., to the Beltsville Research Center.

(j) Emergency Fund for the President, National Defense
(Transfer to Bureau of Agricultural and Industrial Chemistry)

This budget schedule covers obligations under an allotment for travel and special per diem expenses in connection with transfer of employees from Washington, D. C., to field locations at Albany, California; New Orleans, Louisiana; Wyndmoor, Pennsylvania; Manhattan, Kansas; and Madison, Wisconsin.

(k) Working Funds, (Bureau of Agricultural and Industrial Chemistry)

This budget schedule covers obligations under advances, pursuant to Section 601 of the Economy Act of June 30, 1932, for services performed for various agencies as shown in the attached statement of obligations under supplemental funds.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS *

Item	: : Obligations; : 1943	: Estimated : : Obligations; : 1944	: Estimated : Obligations, : 1945
<u>Special Research Fund, Department of Agriculture:</u>	:	:	:
Special research projects	: \$ 58,447	: \$ 62,944	: \$ 62,920
Special research laboratories in major agricultural regions..	: 3,353	: - -	: - -
Total, Special Research Fund	: 61,800	: 62,944	: 62,920
<u>Emergency Rubber Project, Department of Agriculture:</u>	:	:	:
Pilot laboratory investigations on rabbitbrush	: 7,956	: - -	: - -
Pilot laboratory investigations on guayule	: 78,162	: 25,000	: - -
Pilot laboratory investigations on Cryptostegia	: 56,127	: 25,000	: 50,000
Pilot plant investigations on kok-saghyz	: 108,744	: 175,000	: - -
Pilot laboratory investigations on goldenrod	: 105,367	: 140,000	: - -
Pilot plant investigations on guayule	: 10,544	: 86,900	: 100,000
Total, Emergency Rubber Project	: 366,900	: 451,900	: 150,000

* Exclusive of Lend-Lease funds which are not included in the regular Budget

Item	Obligations, 1943	Estimated Obligations, 1944	Estimated Obligations, 1945
<u>Removal and Reestablishment:</u>			
<u>of Arlington Farm, Virginia:</u>			
<u>(transfer to Agriculture):</u>			
Removal and reestablish-			
ment of certain functions:			
and activities from			
Arlington Farm to			
Beltsville, Md.	10,166	- -	- -
<u>Emergency Fund for the</u>			
<u>President, National Defense:</u>			
Travel and special per			
diem expenses in con-			
nection with decentra-			
lization of employees			
from Washington, D. C.			
to the field	4,345	1,100	- -
<u>Working Funds (Bureau of</u>			
<u>Agricultural and Industrial</u>			
<u>Chemistry) Advances from:</u>			
Office of Coordinator of			
Inter-American Affairs:			
Training four agricul-			
tural chemists from			
the Republic of			
Argentina in the			
regional research			
laboratories of the			
Department	7,831	- -	- -
<u>Foreign Economic</u>			
<u>Administration:</u>			
Investigation of			
quality of citrus			
fruits for vitamin			
C contents and de-			
termination if pro-			
duction methods and			
equipment of Brazil:			
conform to United			
States' specifi-			
cations	- -	1,608	- -

Item	Obligations, 1943	Estimated Obligations, 1944	Estimated Obligations, 1945
War Production Board:			
Supervising commercial tests of the Balls-Tucker process for manufacture of alcohol at certain industrial plants	- -	2,500	- -
Investigations in food compression and packaging of dehydrated compressed foods	- -	56,500	- -
Total, War Production Board	- -	59,000	- -
Total, Working Funds	7,831	60,608	- -
Cooperation with American Republics (Transfer from State):			
Interne training for students in chemistry <u>a/</u>	- -	- -	9,400
Total, Obligations under Supplemental Funds	451,042	576,552	222,320

a/ The budget schedule relating to this project appears under the State Department Section of the Budget (see page 625).

PASSENGER-CARRYING VEHICLES

The Bureau of Agricultural and Industrial Chemistry does not contemplate the purchase of any passenger-carrying vehicles in the fiscal year 1945. It is expected that eight automobiles will remain in use.

AGRICULTURAL RESEARCH ADMINISTRATION
Bureau of Human Nutrition and Home Economics

(a) Salaries and Expenses

Appropriation Act, 1944	\$447,420a/
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	468,964
Total anticipated available, 1944	516,384
Budget estimate, 1945	606,630
Increase	<u>90,246</u>

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
1. Foods and nutrition investigations	\$153,820	\$189,068	\$277,100	+ \$88,032 (1)
2. Family economics investigations	90,025	117,412	117,498	+ 86 (2)
3. Textiles and clothing investigations	103,567	124,010	125,959	+ 1,949 (2)
4. Housing and household equipment investigations	29,044	44,962	44,962	---
5. Home economics information	32,399	40,932	41,111	+ 179 (2)
Covered into Treasury in accordance with Public Law 674	139	---	---	---
Unobligated balance	17,765	---	---	---
Total available	<u>426,759</u>	<u>516,384</u>	<u>606,630</u>	<u>90,246</u>
Transferred to:				
"Salaries and expenses, Office of Administrator, Agricultural Research Administration"	+1,000	---	---	
"Salaries and expenses, library"	-41,620	---	---	
Anticipated deficiency for overtime pay		- 68,964		
Total estimate or appropriation	<u>429,379a/</u>	<u>447,420</u>	<u>606,630</u>	

a/ Includes \$31,289 transferred pursuant to Executive Order 9069 of February 23, 1942, from other appropriations, as follows: \$2,435 from "Salaries and expenses, agricultural and industrial chemistry, Agricultural Research Administration," general administrative expenses; and \$28,854 from "Salaries and expenses, agricultural and industrial chemistry, Agricultural Research Administration," agricultural chemical investigations.

INCREASES

The increase of \$90,246 for 1945 consists of:

(1) An increase of \$88,032 under the project "Foods and nutrition investigations," composed of:

(a) An increase of \$86,865 (including \$11,865 for overtime costs) to determine how best to process different kinds of food at home and prevent undue loss of vitamins and other nutrients in cooking and preserving food.

Objective: To determine by analysis and experiment with foods of outstanding importance such as typical meats, vegetables, and fruits, the best methods of household preservation -- canning, drying, freezing -- to retain the most nutritive value and flavor and to prevent spoilage.

The Problem and Its Significance: In the past, foods have been so abundant in the United States that only limited study has been given to conservation of nutritive values in cooking and food preservation. Today, however, new conditions of shortage brought on by the war and new knowledge of the vitamins combine to make the conservation of the nutritive values (especially the vitamins) of foods a problem of major importance. Yet at the same time it is rendered more difficult by the fact that wartime conditions compel the use of new equipment and methods. We have an urgent duty to show how the widespread spoilage losses in home preservation of food can be avoided. More exact knowledge of how to preserve with safety from spoilage, and how to conserve, as far as it practical, the natural vitamin values of foods during preservation and cooking processes, will make possible the improvement of the Nation's health through better meals.

Plan of Work: After developing the best procedures for processing each type of food, studies of flavor and nutritive value will be made by experiments in which the same foods will be run through the different processes of preservation or cookery in the strictest possible parallel tests. Such studies should yield conclusive practical answers as to relative merits of different methods, in place of merely the sketchy "general principles" which science has hitherto had means to work out. To get more rapid results and take account of regional home practices, a number of State agricultural experiment stations will be asked to cooperate in the project. The foods selected will be those that are important in our American diet, and the nutrients studied will be those that are important in each particular food.

(b) An increase of \$1,167 for overtime pay under the War Overtime Pay Act of 1943, not involved in the above increase under this project.

(2) Increases totalling \$2,214 under projects Nos. 2, 3 and 5 for overtime pay required under the War Overtime Pay Act of 1943.

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Bureau of Human Nutrition and Home Economics —

Salaries and expenses: For necessary expenses, including not to exceed [\$169,657] \$222,905 for personal services in the District of Columbia, of the Bureau of Human Nutrition and Home Economics for conducting either independently or in cooperation with other agencies, investigations of the relative utility and economy of agricultural products for food, clothing, and other uses in the home, with special suggestions of plans and methods for the more effective utilization of such products for these purposes, and such economic investigations, including housing and household buying, as have for their purpose the improvement of the rural home, and for disseminating useful information on this subject, [\$416,131] \$606,630.

Because of the greatly increased need for emphasizing the importance and value of improved nutrition for both the civilian population and the armed forces, the research activities affecting human nutrition were grouped in one agency, the work on protein and nutrition in the Bureau of Agricultural Chemistry and Engineering being transferred to the Bureau of Home Economics, and the name of the latter changed to "Bureau of Human Nutrition and Home Economics." The language change merely recognizes this amended title of the Bureau.

Statement of Overtime Costs

	: 1943 :	Est. 1944 :	Est. 1945
Overtime absorbed	: 19,966*	: —	: —
Additional funds for overtime (appropriated, 1943, estimates supplemental, 1944; and included in budget estimate, 1945)	: 9,200:	68,964	: 84,210
Total cost of overtime (7 months in 1943) ..	: 29,166:	68,964	: 84,210

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To determine the kinds and amounts of food, clothing, and other goods and services required in the home for healthful living; to develop methods of using these more efficiently and effectively; and to ascertain facts needed to advise on procedures, programs and policies that would assist families to improve their living levels.

The Problem and Its Significance: The home has a many-sided responsibility in safeguarding the health and developing the morale of the family. These ends may be furthered or weakened by the kind of living the family gets for its expenditure of money, work, and time. Decisions regarding the use of family resources are particularly difficult now because of shortages of goods and help. Adjustments to such changes in an economic situation can be eased through re-evaluation of standards of living. This in turn requires all possible knowledge of the relative economy, usefulness, and importance to living of the various types of goods and services to which we may have become accustomed or among which we still may choose.

General Plan: In the fields of food and nutrition, textiles and clothing, and household equipment, laboratory studies are being made to develop information which will help the homemaker in selective food, clothing and other goods best suited to the purpose, and to assist the family in using these efficiently. Field studies have been made at intervals to ascertain the kind of living had by various groups of the population and the effect upon family living of social changes.

Examples of Progress and Current Program: The following examples of recent accomplishments under this appropriation are cited by fields of work to show progress on some aspects of the broader problems confronted. Other aspects of these problems are cited as indicating the logical next steps to be taken in the research program.

Foods and nutrition investigations: In war as in peace, provision of adequate food for the maintenance of good nutrition stands out as a major problem on the home front. Wise use and conservation of food in the home is second only to production.

Foods to meet the wartime protein shortages: The relative shortages of milk, meat and eggs direct attention to the protein value of certain plant products. Studies of the nutritional quality of the proteins in soybean, peanut and cottonseed products indicate, for instance, that a combination of wheat flour with 5 percent of soya, peanut, or cottonseed flour has 15 to 18 percent more protein and protein of higher nutritive value than wheat flour alone. Cooking and palatability tests already made demonstrate how to use Soya to take the place of from 5 to 15 percent of the meat, fish, eggs and cheese in common dishes; and how to add conservative amounts of soya in making bread, muffins, and a variety of other combinations to increase the food value and make interesting new dishes. A leaflet featuring such recipes has been published.

On account of its great importance, investigations are also being made to find out how large a proportion of soya and peanut products are required as an addition to cereals and vegetables to make maximum contributions to the protein value of such combinations. In line with this, further work on recipe development is also under way. These studies are financed in part by funds allotted by the Food Distribution Administration.

The role of cereals in the wartime diet: The greater emphasis on cereals in wartime diets calls for more exact knowledge of the nutritive value of wheat and its products. Vitamin tests made as a part of a cooperative study with the Bureau of Plant Industry, Soils and Agricultural Engineering, show that different varieties of hard, red, winter

wheat grown in five localities in the Great Plains differ in the vitamin B₁ content according to variety and place grown. Of the eight varieties studied, Tenmarq was the richest in this vitamin regardless of where the crop was grown.

Another study dealing with the effect of storage of wheat on the nutritive value of its proteins shows that no great changes occur during storage for periods up to three years.

Cereals, particularly wheat, will continue during the war and immediate post-war period to form a large part of the diet. A small amount of experimental work is under way to study the highest amounts of cereal grains that can be used in combination with small amounts of scarce foods, such as meat, milk, eggs, etc., to promote good health and high working efficiency.

Vitamin A from plant sources: In times of restricted food supplies people depend more heavily than usual on vegetable foods as a source of vitamin A. The carotene in green and yellow vegetables can be transformed into vitamin A by the human body, but in planning diets it is important to know, as indicated by Bureau research, that 30 to 60 percent more (in terms of International units) is required when carotenes (provitamin A) rather than vitamin A itself are eaten. No work is currently under way on this subject.

Losses in nutritive value of food in Army cooking: In studies supported largely by a one-year grant from the Office of Scientific Research and Development, the Bureau determined the vitamin and mineral content of common foods as cooked in an Army mess. The following are typical of the results obtained:

The losses in vegetables of vitamin C ranged from 45 to 95 percent; of vitamin B₁ from 10 to 30 percent; of niacin about 30 percent; and of carotene (provitamin A) from 0 to 25 percent. Mineral losses occurred especially where large amounts of water were used in cooking or where foods were soaked for a long time. The results were communicated to the proper authorities, with suggestions for reducing such losses. No further work is under way on Army cookery.

Compilation and evaluation of average food values: This Bureau is the only governmental agency supplying figures on the nutritive value of the great variety of foods making up the American diet. A summary table giving the composition of about 250 foods and a table showing the present fragmentary state of our knowledge regarding losses of vitamins during cooking and dehydration were distributed through a National Research Council committee to government war agencies. The Bureau will revise these figures and extend the compilation as new values become available.

Home canning: The unprecedented need for food conservation resulted in an all-time high in home canning in 1943. It was obvious from the beginning that lack of understanding about proper methods could involve health hazards and waste of food through spoilage. As an aid to families who had never canned before and to others faced with new wartime jars, closures, and equipment, the Bureau, in cooperation with the Office of Information, brought existing information on methods and procedures to public attention through leaflets, chart sets, radio talks, press releases and other media. The Department has been and still is under tremendous pressure to provide safe directions for home canning, now greatly complicated by wartime shortages of equipment and supplies.

Tests on home-dried vegetables and fruits: The widespread interest in home drying as a wartime measure raises questions as to what happens to the quality and certain food values of vegetables during the drying process. To answer these, kale, sweetpotatoes, and snap beans were assayed for their vitamin content before and after home-drying and during storage. Of vitamin C, the most sensitive of the vitamins, there was as much as a 90 percent loss during preparation and drying, and the remaining 10 percent was almost entirely destroyed during storage. The vitamin A value did not appear to undergo any appreciable loss during drying, but was reduced about 10 percent during three months storage of the product in glass jars.

In spite of such losses, home-dried vegetables and fruit retain much nutritive value and are a palatable means of introducing variety into wartime meals. Dried in the laboratory by home methods, peaches, pears, blackberries, cherries, and prune plums retained their palatability when kept at room temperature for a year. Vegetable tests included 15 different foods--beets, beet greens, carrots, chard, corn, kale, mushrooms, mustard greens, green peppers, pumpkin, Hubbard squash, snap beans, sweetpotatoes, tomatoes, and turnip greens. Of these, the dried green leaves were among the most satisfactory. They retained their palatability fairly well, deteriorating only slightly in six months' time at room temperature.

These results are based on one method of home drying. Current research is directed toward finding which of several methods will best conserve palatability and vitamin C value. This will include the study of the effect of each step in the drying process, i. e., precooking, drying, packaging, and storing on the final product.

Effect of storage on the quality of commercially dehydrated eggs: Commercially dehydrated eggs are being shipped abroad under Lend-Lease for household use in other countries. To find the effect of storage time and temperature on their palatability and cooking properties, samples of dried egg from five processing plants were tested, as part of an interbureau cooperative study, after storage at temperatures ranging from 0° to 110° F. and at various intervals of time up to 56 weeks. The importance of proper storage conditions became obvious. Dried eggs stored at temperatures below 60° F. retained their original palatability at least one year; when stored at 68° or 75° F. there was gradual deterioration and the dried eggs were found unsuitable for use in scrambled eggs after four to seven months in storage. At temperatures above 75° F. there was a rapid

deterioration in palatability.

Family economics investigations: Essential to the wartime programs of rationing, taxation, and planning agricultural production in terms of human needs, are facts on the goods and services American families need and are accustomed to buy and use in their homes.

American food habits in war and peace: In 1935-36, about one-third of American families were found to be ill-fed in a nation embarrassed by huge food surpluses. In the spring of 1942, according to a Bureau study made in part under a special allotment, family diets were considerably better in nutritive quality, both among rural and urban populations. With higher incomes and more money to spend for food, consumers brought more of the foods that contribute to good nutrition--milk, fruits, and vegetables, eggs, and meats--than they did in 1936. Such studies of family diets made at frequent intervals enable us to find our dietary weaknesses and to measure progress toward achieving freedom from want of food and assuring nutritional well-being for all.

Nutritive value of American food supplies: The conduct of the war requires that the American public be well fed at the same time that food is sent to the United Nations and occupied countries. The Bureau this year furnished the War Food Administration with estimates of the nutritive value of the per capita food supply for 1943 and for recent pre-war years. Such estimates will be continued year by year or whenever there is a major change in the food supply situation.

Diets to match food supplies: Can families be well fed even though some foods are not always obtainable and others are scarce? Master diet plans at different cost levels, developed by the Bureau and widely used in national food planning, were revised this year to meet wartime conditions, and will be further revised as food supplies change. These plans show families how to plan their diets to fit income, and how to provide each member of the family with the amounts needed of vitamins, minerals, and other dietary essentials.

Family spending and saving: Whether families use all of their incomes to buy goods and services for immediate enjoyment or save a portion for future purchases or to lend to the Government to help finance the war makes a great difference in the economic situation of the United States.

The Bureau's studies of rural family spending and saving made in part under special allotment have provided data on such vital subjects as the amount and distribution of farm family income; the quantities and kinds of food which families use and how this measures against nutrition standards; the way families spend for clothing, house furnishings, education, medical care and other items important to family living. These facts have helped to shape public policy through their use by the Treasury Department, the Office of Price Administration, the War Production Board, and other government agencies. They have also provided information that assists families to plan their budgets and to make the best use of their incomes.

The most recent study, "Rural Family Spending and Saving in Wartime" (Misc. Pub. 520) yielded information on family income, savings, taxes and family living expenditures in 1941-42. The original data are being further analyzed and compared with others studied to show trends in family expenditures so that there will be a continuous picture of the foods and services needed by American families as a basis for national planning.

Family budgets: Because there has been no fully satisfactory method of comparing the real incomes of farm families with the real incomes of urban workers, budgets for farm and nonfarm families that represent comparable living standards are being developed as one step in this process.

The development of standard budgets is a type of analysis in which existing data are used for special purposes. The budget consists of two parts, one a descriptive list of goods and services that constitute a specified standard of living, the other a method of pricing such goods and services. Budgets heretofore developed have been used in relief administration, in minimum wage administration and in collective bargaining for wage adjustments. Present emphasis is being laid upon the development of rural and urban family budgets that may contribute to the development of research upon problems of family income.

Digest of economic facts affecting farm family living: To meet repeated demands from the Extension Service and representatives of other agricultural agencies who work directly with farm families, a monthly digest of information on economic changes and government regulations affecting farm family living was instituted during this year by the Bureau. It will be continued during the post-war period.

Textiles and clothing investigations: Retail stocks of clothing and household textiles accumulated in 1939 and 1940 as war backlogs are fast becoming depleted. Wartime shortages of fiber, textile machinery and mill and factory man power are now being felt by the civilian population. The research in the Division of Textiles and Clothing is focused on giving the country's homemakers all possible help with clothing conservation, selection, and care, in order that their families may have healthful clothing and adequate household textiles during wartime and the period of post-war adjustment.

Conservation of clothing and household textiles: While the war lasts and for some time thereafter, clothing conservation will be of the utmost importance. The Bureau is therefore devoting considerable attention to this subject. For example, to prevent waste of wool, always a strategic fiber in wartime because of its warmth and protective qualities, the Bureau is preparing and issuing information designed to aid homemakers: (a) Conserve wool material, through proper care, based on scientific knowledge of the wool fiber; (b) salvage suits discarded when men go into uniform, by making them over into usable garments for other members of the family; and (c) prolong the life of civilian-tailored garments by using professional techniques in repairing wool suits and reconditioning the garments throughout.

To aid in conserving sheets, towels, blankets, and other household articles and clothing, some of which are practically irreplaceable for the duration, directions have been issued for new improved methods of mending all of the common types of wear and tear on fabrics. The Bureau is now investigating professional methods of reweaving and renovating carpets and rugs, and plans to adapt these so as to give homemakers expert instructions for this work while war labor shortages reduce commercial repair services.

Clothing and fabric care: Thousands of yards of fabric are wasted annually through improper cleaning and storage of clothing and yardage. Damage due to improper storage is likely to increase now that civilian clothing of men and women in the armed forces as well as larger quantities of household textiles are being packed away. Almost no scientific data exist to answer the questions homemakers ask in regard to storage requirements of different types of fibers and fabrics. The need for efficient home laundering and drycleaning methods is also assuming greater importance now that lack of manpower is closing many laundries and drycleaning plants.

The Bureau through an exploratory study of certain cotton, linen and wool fabrics has shown that temperatures commonly prevailing in attics, the action of light, and in the case of cotton fabrics, starch and other sizing materials, cause clothing and fabrics to deteriorate during storage. It has not been determined whether the results can be applied to other varieties of textiles and storage conditions.

Chemical finishes as preventatives of fabric deterioration:

Great losses occur due to the staining and deteriorating action of bacteria and fungi on fabrics, much of which probably could be prevented by protective yarn and fabric finishes. For example, working to find effective cheap mildew-resistant treatments for cloth, textile specialists in the home economics laboratories recently completed tests on 150 such treatments. About a third of these proved to be satisfactory. This year also a method was reported for determining the effectiveness of mildew-resistant treatments on awnings, porch furniture, and other outdoor furnishings. Research is now being pushed to aid in prolonging the life of the great quantity of cloth needed yearly in agriculture. Treatments for covers for tobacco seedbeds and for tree seedlings are being studied. Further experimentation looking toward the discovery of treatments suitable for house furnishings and clothing exposed to tropical conditions of heat and moisture are also under way. This work is in cooperation with other agencies.

Women's and children's clothing: Carrying further the Bureau's pioneering accomplishments in women's work clothes, which started a new development in the garment and pattern industries, the Bureau is designing women's and children's clothing to meet special needs as they arise in the war program. For example, in cooperation with the Extension Service, a uniform for the Women's Land Army was developed. Seventeen other designs adapted to different occupations were initiated in the Bureau and produced by four commercial pattern companies for Nation-wide distribution. At the request of a large aircraft company, three protective outfits and work aprons were designed for women employed in airplane construction. This work is being extended to include uniforms for additional types of industrial and outdoor

and indoor clothing and simplified clothing for infants and children. These designs will be based on detailed studies of the needs and activities of the individuals concerned.

Cotton hosiery: Need for making the best possible use of available supplies of cotton is the wartime purpose for continuing studies of different hosiery constructions and of different varieties of cotton when manufactured into hose and other knit articles of clothing. Recent service studies on hose made from three American-Egyptian cottons and from shorter staple American Upland showed no difference in durability and but little difference in rate of chemical deterioration, thus demonstrating from these standpoints that the longer staple can well be conserved for military use. Work is going forward on the development of chemical finishes to improve the strength and elasticity of yarns from American-grown short staple cotton and for the use of single instead of ply yarns--thus saving machinery and manpower. Further work is being planned to develop constructions and finishes for knit fabrics that would broaden their usefulness. These plans contemplate the study of cotton alone, and cotton blended with other fibers, and its application not only to hosiery but also to other types of knit fabrics, especially for materials for undergarments, and for children's wear.

Home construction of clothing: Reduced manufacture of ready-to-wear clothing due to the shift of factory workers to war industries makes home sewing increasingly necessary in wartime. The sale of patterns increased more than 25 percent last year and is more than double what it was in 1940. Many women who never sewed before for themselves and their families must attempt it now. Unless supplied with simple, reliable instructions, waste of already scarce materials is bound to result. For the use of homemakers and of the extension workers and teachers conducting classes in wartime clothing construction, the Bureau is being called upon for publications giving step-by-step directions for making important articles of clothing, and such material is now in preparation. These will give homemakers the benefit of time-saving professional methods of garment construction until factories can resume normal production of civilian goods.

Housing and household equipment investigations: Because of the present drastic limitation on materials for building houses and manufacturing household equipment, the research in this division is now concerned chiefly with conservation of equipment, and studies of equipment and methods used in home food preservation.

Household equipment conservation: To assist homemakers in the proper care and use of major household labor-saving appliances, thus helping make equipment last until factories can again turn to production of civilian goods, the Bureau published, during the past year, seven leaflets and two series of educational wall charts. These cover washing machines, refrigerators, ironing equipment, gas and electric ranges, sewing machines, vacuum cleaners, and electric cords and plugs.

Home food-drying equipment: To aid families handicapped by lack of pressure canners and other canning equipment in preserving Victory Garden products, research was continued on home food driers. Designs for three new or improved portable driers were completed and distributed to the public. The top-of-stove drier, for use on any kitchen stove burning gas, liquid fuel, wood, or coal, calls for practically no strategic material and has a capacity of five to ten pounds of raw food as prepared for drying. Satisfactory methods of drying in gas and electric range ovens were developed, and issued together with diagrams for building trays, as well as complete "how-to-do-it" directions for handling the common fruits and vegetables. Building plans for a homemade electric dehydrator were developed and made available to families having a portable 1/4 horsepower motor and screw-in type of brooder heating elements. The fan is made of wood, and the only strategic materials required are a thermostat and electric wiring.

Studies now under way center on decreasing the drying time in household electric food driers and maintaining uniform temperature throughout the drying period so as to obtain a product of highest possible palatability and nutritive value. These studies deal specifically with the best place to locate the thermostat and the use of a thermostat with a calibrated dial that the homemakers can set to the temperature best suited to each product. These studies will complete the work that the Bureau expects to do in developing an emergency type of home-made dehydration equipment. The plan is to use the resources now being devoted to these problems to accelerate work under way on home freezing.

Freezing equipment and methods: Individual farm freezer and storage cabinets have been put on the market by a number of manufacturers not equipped with laboratory facilities for developing adequate instructions for household operation. Consequently food is being wasted through lack of knowledge on how to prepare and package the food for freezing, and how much of a load can safely be put into the freezer at one time.

On a very small scale, work is now under way to compare methods of pretreating foods for freezing. In order to develop methods, it is necessary to determine what blanching temperatures and times are required under home conditions to destroy enzyme activity; and the effect of type of utensil on blanching times and temperatures. Plans for future work involve studies of the best temperatures for freezing and storage from the standpoint of eliminating spoilage and of maintaining quality and nutritive value of the food; how much fluctuation of temperature stored frozen foods can stand; what capacity of freezer and storage cabinet do farm families need.

Home economics information:

Information for wartime living: The government's wartime program for use of food, clothing, and other civilian goods is furnished to the public through a series of campaigns. To implement these, there

must be authoritative how-to-do-it information quickly prepared and widely distributed in quantity to reach the majority the Nation's homes. From its current research and backlog of scientific findings, the Bureau of Human Nutrition and Home Economics was able to furnish the basic printed materials for four such home front programs this year--the voluntary share-the-meat campaign; the home food preservation campaign; and the nutrition and food conservation campaigns. The last three mentioned will continue at an accelerated pace in the year ahead.

From July 1, 1942 to December 1, 1943, 40 printed publications were prepared or revised, and 65 picture charts prepared.

(b) Special Research Fund, Department of Agriculture
(Allotment to Bureau of Human Nutrition and Home Economics)

This budget schedule covers obligations under an allotment for special researches in nutrition.

(c) Liquidation and Management of Resettlement Projects
(Allotment to Bureau of Human Nutrition and Home Economics)

This budget schedule covers obligations under an allotment for the testing of textile materials sold on resettlement projects.

(d) Emergency Fund for the President, National Defense
(Allotment to Bureau of Human Nutrition and Home Economics)

This budget schedule covers obligations under an allotment for a study of spending and saving of rural families in wartime.

(e) Exportation and Domestic Consumption of Agricultural Commodities
(Allotment to Bureau of Human Nutrition and Home Economics)

This budget schedule covers obligations under an allotment for a study of the utilization of agricultural commodities, including soybean and peanut concentrates.

(f) Working Funds (Bureau of Human Nutrition and Home Economics)

This budget schedule covers obligations under advances, pursuant to Section 601 of the Economy Act of June 30, 1932, for services performed for various agencies. The detailed advances are included in the following statement of supplemental funds.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS

Item	Obligations, 1943	Estimated obligations, 1944	Estimated obligations, 1945
<u>Special Research Fund: For special</u>			
researches in nutrition.....	\$22,173	\$47,675	\$55,755
<u>Liquidation and Management of Resettle-</u>			
<u>ment Projects: For testing textile</u>			
materials sold on resettlement			
projects.....	1,772	- -	- -
<u>Emergency Fund for the President,</u>			
<u>National Defense: For study of</u>			
spending and saving of rural families			
in wartime.....	18,013	- -	- -
<u>Exportation and Domestic Consumption</u>			
<u>of Agricultural Commodities: For</u>			
study of utilization of agricultur-			
al commodities, including soybean			
and peanut concentrates.....	42,932	44,460	44,460
<u>Working Funds (Bureau of Human Nutrition</u>			
<u>and Home Economics):</u>			
Investigations regarding conserva-			
tion and nutritive values of			
fruits, vegetables and cereal			
grains with special reference to			
losses during marketing, cooking			
or home preservation. (Advance			
from Office of Scientific Research			
and Development).....	14,666	- -	- -
Investigations in food compression			
and in packaging of dehydrated			
compressed food products. (Advance			
from War Production Board).....	- -	11,300	- -
Total, Working Funds.....	14,666	11,300	- -
Total obligations under supplemental			
funds.....	99,556	103,435	100,215

AGRICULTURAL RESEARCH ADMINISTRATION

(a) Beltsville Research Center

Appropriation Act, 1944	\$100,560	
Anticipated deficiency for overtime pay required by the War Overtime Pay Act of 1943	+16,000	
Total anticipated available, 1944	116,560	
Budget estimate, 1945	130,760	
Increase	+14,200	(1)

PROJECT STATEMENT

Project	1943	1944 (estimated)	1945 (estimated)	Increase or decrease
Beltsville Research Center...	\$111,346	\$116,560	\$130,760	+\$14,200 (1)
Unobligated balance.....	1,509	- -	- -	- -
Total available.....	112,855	116,560	130,760	+ 14,200
Anticipated deficiency for overtime.....	- -	-16,000	- -	
Total estimate or appropriation	112,855	100,560	130,760	

INCREASE

(1) An increase of \$14,200 (including \$1,700 for overtime pay) is required for essential road repair and maintenance at the Beltsville Research Center, Maryland.

Objective: To repair and maintain approximately 49.2 miles of roads.

The Problem and Necessity: In prior years, the Beltsville Research Center appropriation supplied approximately \$10,000 for materials and equipment for road maintenance and the necessary labor was provided by the Civilian Conservation Corps. Since the C.C.C. has been discontinued, the required labor for road maintenance must be supplied by the Center. Due to a reduction in the appropriation, it has been necessary to curtail the road-maintenance program during the fiscal year 1944. The alternate freezing and thawing in winter causes pits in the roads. Rains cause washing along the shoulders. The heavy traffic increases the damage. There are now holes in the roads and erosion along the shoulders which become increasingly worse as time goes by, thus intensifying the need for repair and proper maintenance.

Various bureaus at the Center are performing essential agricultural research and it is necessary that the Center roads be adequately maintained for proper conduct of work at the Center. During the current fiscal year, as well as the past fiscal year, it has been necessary to curtail the road-maintenance program due to the lack of sufficient funds. Continued lack of adequate road maintenance funds would further jeopardize the investment in roads.

Plan of Work: The necessary redressing of roads and patching will be done under supervision of the Center maintenance force, employing necessary temporary labor, or where expedient, will be done by contract. With present funds, it is possible to provide only \$5,000 for road maintenance. The recommended increase of \$14,200 will provide a total operating budget of \$19,200 for maintenance. This is a minimum standard for maintenance which will average approximately \$5⁴³ per mile for 31.4 miles of bituminous surfaced roads and approximately \$120 per mile for 17.8 miles of gravel roads.

CHANGE IN LANGUAGE

The estimates include a proposed change in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

For general administrative purposes, including maintenance, operation, construction of necessary buildings at a cost of not to exceed \$7,500 for any one building, repairs, and other expenses, [~~\$100,560; which appropriation may be augmented, by transfer of funds or by reimbursement,~~] \$130,760: Provided, That the appropriation current at the time services are rendered or when payment therefor is received, may be reimbursed (by advance credits or reimbursements based on estimated or actual charges) from applicable appropriations, to cover the charges, including handling and other related services, for equipment rentals (including depreciation, maintenance, and repairs); for services, supplies, equipment and materials furnished, stores of which may be maintained at the Center, and for building construction, alteration, and repair performed by the Center in carrying out the purposes of such applicable appropriations and the applicable appropriations may also be charged their proportionate share of the necessary general expenses of the Center not covered by this appropriation.

The change proposed in the language of this item strikes out the words "which appropriation may be augmented, by transfer of funds or by reimbursement" and inserts the following: "Provided, That the appropriation current at the time services are rendered or when payment therefor is received, may be reimbursed (by advance credits or reimbursements based on estimated or actual charges)". This will enable the Center to receive reimbursements in advance for work for bureaus and agencies. It is proposed to strike out the word "augmented" because this term is misleading, since this appropriation is not in reality "augmented" for services rendered but is merely "paid back" for the costs of such services. The words "by transfer of funds" are being deleted as unnecessary if the authority for advance reimbursements is provided.

The authorization contained in the recommended language is to facilitate the Center management organization in meeting its current obligations as they come due throughout the fiscal year. At present, the direct appropriation for the Center is insufficient to permit the Center to pay its bills currently because of the volume of reimbursable work performed for other agencies. As a result of this wide divergence between available working capital and reimbursable work performed and of the fact that collections require such long periods of time to accomplish, it has been necessary at various times to suspend payment of current vouchers. For example, vendors are sometimes required to wait until July or August to receive payment for materials or services furnished during February or March.

The use of the present "transfer of funds" procedure has the undesirable feature of decreasing the base appropriations from which the transfers are made, thus making the basic accounting records of the transferring bureaus at variance with reports which must be made on the basis of funds obligated for subject matter activities or commodities. In other words, if a report is required on obligations for work on "diseases of animals", for instance, the basic accounting records for the subappropriation covering this work would not reflect the obligations for services performed by the Beltsville Research Center in connection with such work.

While the Center has authority to receive advances from other agencies through the establishment of working funds, under Section 601 of the Economy Act of June 30, 1932; this procedure would be too costly since many bureaus and appropriation items are involved and numerous separate accounts would have to be established and maintained.

Statement of Overtime Costs

	: 1943	: Est. '44	: Est. '45
Overtime absorbed	*\$44,211	\$98,400	\$98,400
Additional funds for overtime (appropriated, 1943, estimated supplemental, 1944; and included in budget estimate, 1945)	7,000	16,000	17,700
Total cost of overtime (7 months in 1943) ..	51,211	114,400	116,100

* Difference between overtime cost and supplemental appropriation.

WORK UNDER THIS APPROPRIATION

Objective: The orderly development of the Beltsville Research Center and the maintenance of operating services and related management functions

Necessity: This appropriation provides, not for research work, but for over-all operating services and related management necessary to the efficient conduct of the research work performed at the Center by various agencies of this and other Departments, such as operation of a sewage disposal system; centralized purchasing of fuel, feed, and other supplies; procurement and maintenance of fire protection equipment; construction and maintenance of roads; operation of mail and messenger services; construction and maintenance of water, gas, and electric distribution lines; provision for emergency first aid service; furnishing of central telephone and guard services; and maintenance of administrative services in connection therewith.

Direct services furnished to the bureaus, such as heat, electricity, gas, and water, the repair and maintenance of structures and equipment and the conduct of general farm work, as requested by the bureaus, are performed on a reimbursable basis.

Increase in Activities: During the past fiscal year, continued progress has been made by the Beltsville Research Center in efficiently serving the bureaus at the Center. The transfer of additional personnel and their work from Washington to the Center has been continued by the various bureaus of the Department and other agencies. The Center now serves 2,140 people in the following bureaus and agencies of the Department, an increase of 258 since February 1943: Bureau of Animal Industry; Bureau of Dairy Industry; Bureau of Entomology and Plant Quarantine; Office of Distribution; Forest Service; Library; Bureau of Plant Industry; Soils, and Agricultural Engineering; Soil Conservation Service; and Bureau of Human Nutrition and Home Economics. In addition the Center serves the following agencies outside the Department of Agriculture: Radio Section, Bureau of Standards; Food and Drug Administration; War Department; and Navy Department.

Due to the diverse nature of the activities of the various agencies and the conversion of their normal programs to work contributing directly and indirectly to the war effort, there has been an increased demand for maintenance requirements, with which the Center has kept pace.

The establishment of full-time guard service which was inaugurated in the previous fiscal year throughout the most critical areas of the Center was further improved during the past fiscal year by the addition of a central guard office which provides control on a twenty-four hour basis. The conversion of a number of the heating plants at the Center from the use of fuel oil to coal was effected during the year, due to the critical shortage of fuel oil.

(b) Public Works Administration, Act of 1938
(Allotment to Beltsville Research Center)

This budget schedule covers obligations incurred in 1943 under an allotment for the construction of certain laboratories, administration building, central heating, refrigeration and service buildings, extending the water system, enlarging facilities at the grain and feed mill, and the construction of new roads.

(c) Emergency Fund for the President, National Defense
(Allotment to Beltsville Research Center)

This budget schedule covers incidental obligations under an allotment for expenses in connection with moving certain facilities of the Bureau of Animal Industry from Washington, D. C., to the Center.

(d) Working Fund (Beltsville Research Center)

This budget schedule covers obligations under an advance pursuant to Section 601 of the Economy Act of June 30, 1932, for emergency guards at the central guard office of the Center.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS

	Obliga- tions, 1943 :	Est. : : obliga- : tions, : 1944 :	Est. : obliga- : tions, : 1945 :
Public Works Administration, Act of 1938 (Allotment to Beltsville Research Center):	:	:	:
Construct laboratories, administration, central heating, refrigeration and service buildings	\$ 9,535:	- - :	- -
Extend water system, construct new roads, enlarge facilities at grain and feed mill	4,456:	- - :	- -
Total, Public Works Administration	13,991:	- - :	- -
Emergency Fund for the President, National Defense (Allotment to Beltsville Research Center): For moving certain facilities of Bureau of Animal Industry to Beltsville Research Center	15:	- - :	- -
Working Fund (Beltsville Research Center): Advance from Public Buildings Administration: For emergency guards at the central guard office..	- - : \$5,475	:	- -
Total, Obligations Under Supplemental Funds ...	14,006:	5,475 :	- -

PASSENGER-CARRYING VEHICLES

No additional purchases of passenger-carrying vehicles are contemplated. The six vehicles operated will be used for essential transportation in connection with the supervision of Center activities.

